AMERICAN MACHINIST

June 11, 1941

1600 a Day—*Six inspectors are kept busy putting the final O. K. on 3-in. anti-aircraft shell at the S. A. Woods Machine Company*

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Walling Out Aggressors

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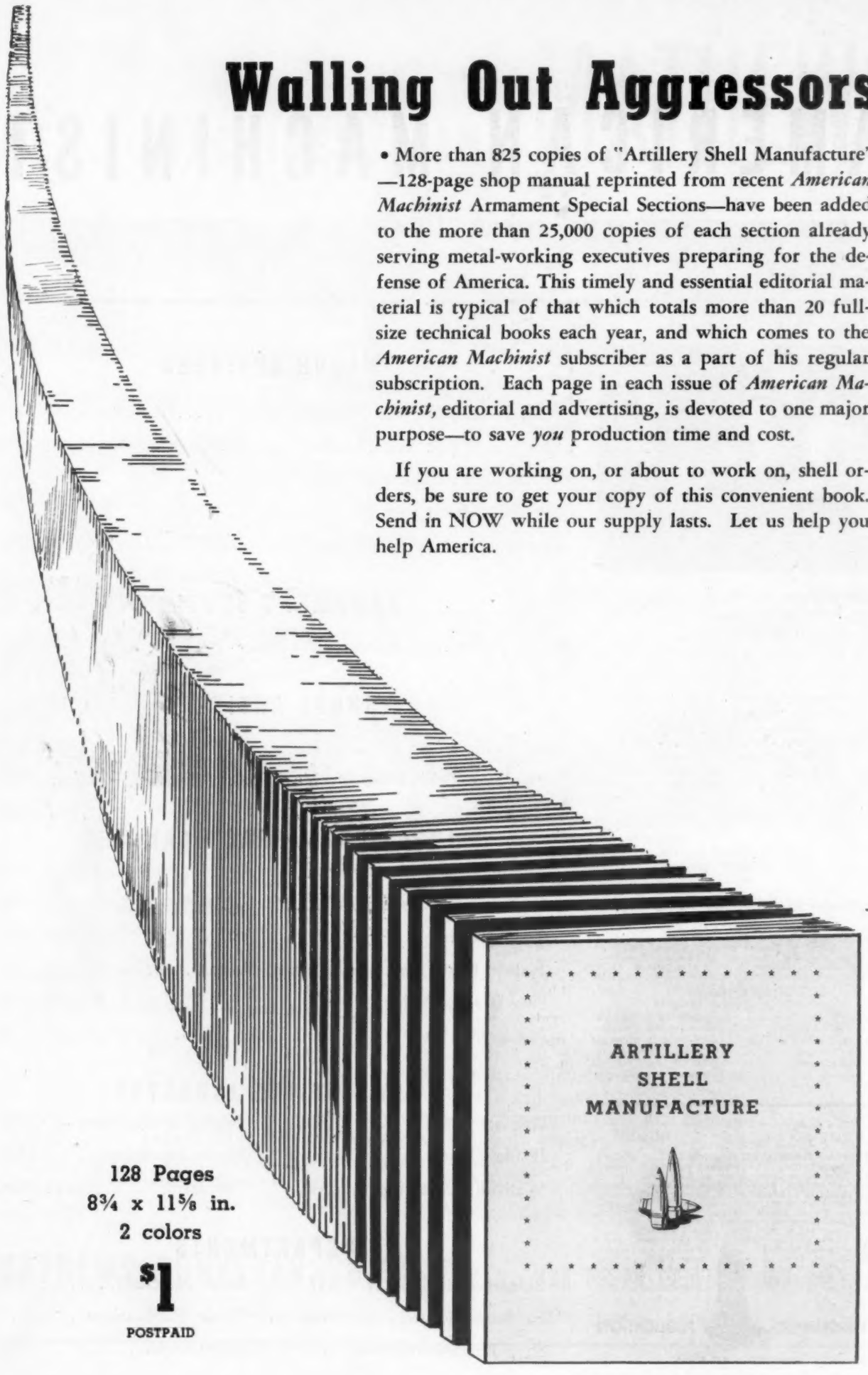

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WHAT'S IN THIS ISSUE

ANTI-AIRCRAFT SHELL

The S. A. Woods Machine Company, of Boston, Mass., is producing 3-in., high explosive, anti-aircraft shell. Although the company got much of its experience during World War I when it made shell for the U. S. Army and attained a working knowledge of the problems involved, modern equipment had to be installed, conveyor lines arranged, and machine operators and inspectors trained before efficient production could begin again. This story and the story of actual manufacture is told in "Line-Production of 3-in. A.A. Shell" beginning on page 541.

PLASTICS—NOT METALS

Can plastics replace metals? They have already done so in certain cases. Then, too, under war economies changes come faster than normally and if war is accented more strongly in the U. S., which seems likely, plastics may become an American ersatz product. Herbert Chase tells about it on page 527.

HERBERT CHASE

DELETES DISTORTION

R. W. Fisher of the National Rubber Machinery Company knows how to minimize the distortion factor which has often been the plague of many welding shops. The answer is to coordinate design and procedures. Beginning on page 534, he tells about "Welding by Sub-Assemblies."

THE MAN BEHIND

An unsung hero, "The Man Behind the Machine Tool," makes it possible to attain optimum production, ceaseless operation, efficient performance. Fred H. Zoellner, director of machine shop, Ohio Mechanic Institute, extols him on page 580.

A LITTLE INGENUITY

Precision boring machines may be easily adapted to perform facing, threading, turning, counterboring, and chamfering operations. On page 537, G. D. Stewart, chief engineer, standard machinery, Ex-Cell-O Corporation, tells you how to do it in "Precision Boring—Plus."

G. D. STEWART

REVISED EDITION

If you didn't know that the standards of the chemical composition of the Society of Automotive Engineers steels have been revised and now include only 84 in place of the 109 used heretofore —then read the data on page 557. The information is so valuable that we have included it as part of American Machinist's Reference Book Sheets.

IDEAS ARE TOOLS

A good idea is often worth more than a warehouse full of the latest machine tools. In fact, good ideas are really new tools and some of them may be had for the asking. Here are the latest:

To turn work in a lathe to specifications given in millimeters may seem perplexing but Ernest Berger found an easy way to do it. His idea is on page 556.

A sine bar that can be used for wide angles includes a protractor in design. William S. Rowell gives the reasons on page 556.

It's a cinch to calculate the tool depth for threads. If you don't think it's really that simple, turn to page 555 where George J. Schmidt will set you straight.

L. D. JENNINGS

TROUBLE WITH X-RAYS

When X-rays are used to examine metal products which are smaller than the negatives used in the process, the secondary rays often over-expose the outer edges of the picture making it difficult to read. L. D. Jennings, manufacturing engineer, generator works department, Westinghouse Electric & Mfg. Co., reveals how to prevent it in "Powder Improves Radiograph" beginning on page 553.

COMING

Wright Aeronautical Corporation is producing aircraft engines at a rate of 1,500,000 h.p. per month, six times the concern's output in 1939. The story of Wright's efforts to increase production of radial air-cooled engines in the Paterson, N. J. area will be told in a new Armament Section in an early issue. Scheduled, too, for an early appearance is the experience of the General Electric Company in subcontracting work. In another article, George B. Fuller, director of training, will tell how Bell Aircraft added over 6,000 new workers to the company's roster in a year. In the very next number, we begin a new series of articles on Flame-Hardening by J. D. McGrath, applied engineering division, Air Reduction Company. The information is so valuable you will want to place this on your "must" list.

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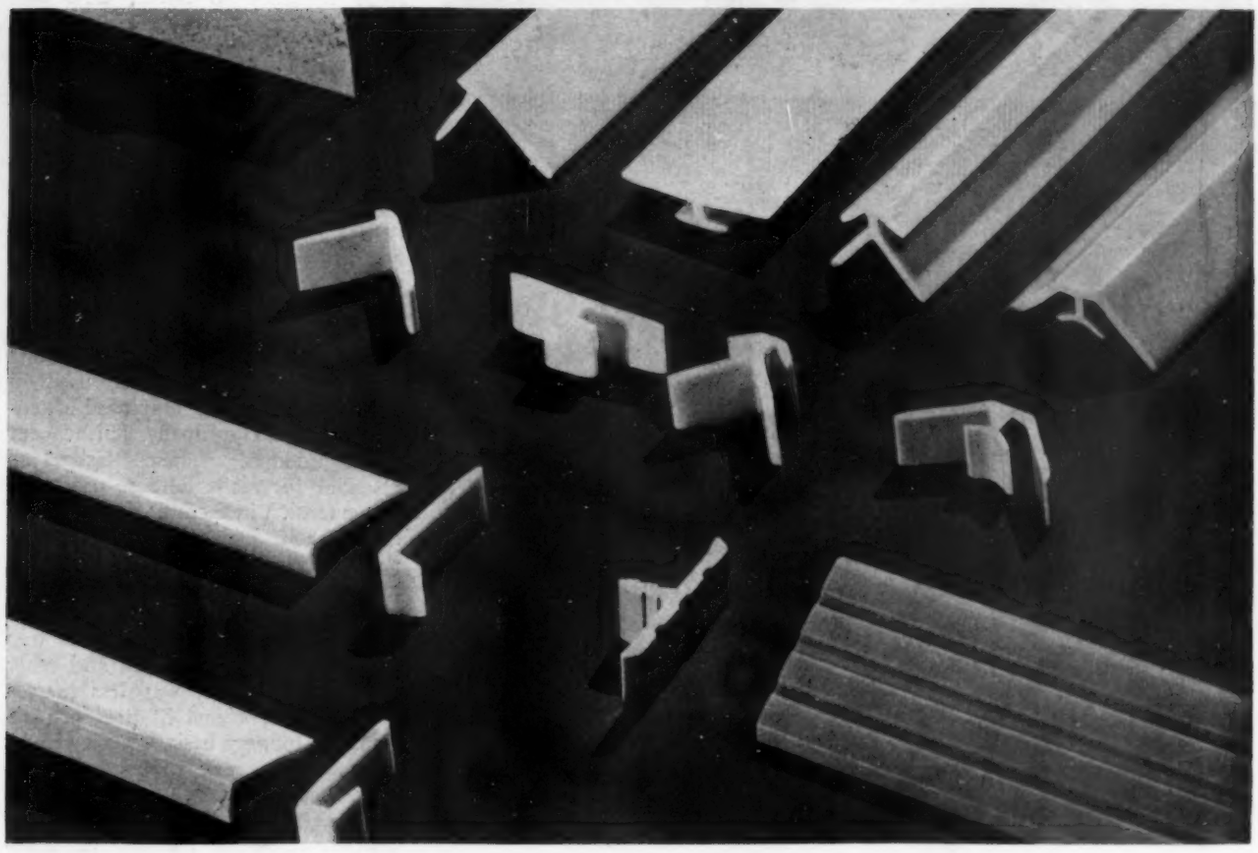


Extruded plastics of cellulose acetate can sometimes be substituted for aluminum moldings or for sheet steel

Can Plastics Replace Metals?

BY HERBERT CHASE

They have already done so for certain applications, and war time economy may speed up the process. In making a change, the limitations must be remembered

ASK ANY NUMBER of supposedly qualified individuals whether plastics can displace metals, and no two replies will agree in most major respects. Why? First, because the correct answer is necessarily involved. In fact, there are many correct answers, each of which necessitates qualification. Secondly, those thoroughly familiar with metals are often none too well informed about plastics, and some of those who know a lot about plastics have an inadequate understanding of the relative place of these two types of materials to the manufacturing picture as a whole.

The question may be divided into the following parts:

1. What relation do plastics have to the "defense economy" now prevailing?

2. What of the *adequacy* of plastics in replacing metals?

3. What about the *availability* of plastics to replace metals?

4. What effect will the availability of trained labor have on the possible substitution of plastics for metals?

5. How would production capacity and equipment be affected by an extensive shift from metals to plastics?

6. What effect will a shift to plastics have upon customer acceptance of the product involved?

1. Effect on Defense Economy

A primary reason for the prevalent talk about substituting plastics for metals is need of relieving the present "tight" situation in respect to certain metals, especially aluminum and zinc, required in the rearmament program. Few will disagree that the substitution should be made, providing the effect

Photographs by courtesy of Bakelite Corporation and the Tennessee Eastman Corporation.

Transparent plastics, as exemplified by this oil can, can be used for some metal parts

on metal shortages will be significant and providing it will not introduce other complexities which may lead to a worse rather than a better over-all situation.

A few aircraft parts which have been made of aluminum are being replaced by plastics, but the total effect may not prove of far reaching significance. Yet the much-talked-of use of plastic-bonded plywood in aircraft, especially for training purposes, appears to hold much promise. As the percentage of plastic (strictly speaking, of resin such as is used in making plastic) is understood to be around ten per cent in the plywood parts, the development may properly be considered one in which wood rather than plastic is the replacing material. Nevertheless, if the plastic-bonded plywood plane (often referred to as the "plastic" airplane) becomes as large a factor as some observers foresee, it may require a large proportion of the phenolic resins, and perhaps of the urea resins, now going into plastic moldings. Such use of plastics may well release considerable tonnages of aluminum for other aircraft and related armament uses with beneficial results. It might have, however, a considerable effect upon the supply of certain plastics for other uses.

The automotive and the electrical industries are now the largest users of plastics. Automotive ignition systems, including those used on cars, trucks, aircraft and all automotive equipment (except diesel types), require plastic parts. A great variety of plastic parts is needed for communication systems and other electrical applications important to the Army and Navy. Transparent inclosures for aircraft cockpits, gun turrets and the like, are already taking a large proportion of acrylic plastic production and smaller proportions of other transparent plastics, a fact which should not be overlooked even though transparent plastic is seldom used in place of metal.

Considerable plastic, both opaque and transparent, is being used in making gas masks, and much larger quantities may be needed. Plastic, being light in weight and highly resistant to chemical attack, including corrosion, is well suited for some gas mask parts. Some eye pieces are being made from transparent plastic. They are light and resist shattering, but have some tendency to attract dust and scratch easily. Metal gas masks parts may also be replaced by plastics.

A large proportion of plastic applications are made in combination with metal parts to provide adequate strength or to prevent warpage. In such cases, the plastic may still displace considerable metal, but when it merely adds to the number of parts and necessitates extra tooling it may not yield the extra economy sought.

Plastics, as such, are not ofen used as finishes, although they seldom require an applied finish. The same general types of materials, used in making plastics, are employed extensively in making many finishes for metal products. These finishes are essential for many defense uses, and any extension in the use of plastics for non-essential purposes should not be such that it will cause a shortage of needed finish materials.

The total production of plastics in 1939, including those which went into finishes as well as molded and other plastic applications, was less than a third of one percent of steel production on a tonnage basis. Plastic weighs on an average one sixth as much as steel, but its strength is seldom one sixth as great. Even if plastic production could be doubled or quadrupled within the coming year—which would be a tremendous undertaking—the total effect on metal utilization could not be great.

2. Adequacy of Plastics as Metal Substitutes

The substitution of plastics for metals is chiefly, though not entirely, confined to parts which are largely decorative or are lightly stressed in service. Exceptions are found in aircraft parts and in mechanical elements, such as gears, but in these the plastic depend largely upon wood, fabric or paper for strength and shock resistance. Where the substitution can be made, it is seldom wise to permit it unless there is definite proof that substantially identical applications have proved satisfactory.

The president of a prominent company making plastics is reliably reported as saying: "If the product is satisfactory in its present form, I advise that it be not converted to fabrication in plastics, as it certainly will cost more and it may not prove satisfactory." This advise is given, perhaps, without special reference to defense economy, but its wisdom is hardly questioned by impartial observers. Other makers of plastics are genuinely concerned lest plastics be

applied where they are not well suited with consequent troubles which may be laid against them.

Among the fairly extensive substitutions of plastic is that in replacing washing machine agitators (formerly aluminum alloy castings) with a special phenolic plastic molded to shape. In this lightly stressed part, lightness and resistance to soap solutions are desired. The plastic provides these, but it required two years of experiment to develop molded agitators which were satisfactory.

It is apparent that a shift to plastics, although entirely feasible under certain favorable circumstances, is likely to demand a lengthy period of experiment before the change can be brought about.

The same need for development work is illustrated in the Ford efforts to develop a plastic body shell. Reports indicate that this experience is developing favorably, so far as finding a suitable plastic is concerned, but it has taken some two years and a large expenditure to do this. It is still undetermined whether the proposed plastic body will satisfy requirements. If this is determined favorably a revolutionary change in manufacturing procedure will be required, including plants to prepare the raw materials, to process them, to mold them on a large scale and to assemble them into a body shell. Even if all these turn out favorably, the final product may prove more costly than that which it is intended to replace. The proposed body of plastic is to have a steel frame which constitutes some 60 per cent of its total weight. Only an organization comparable to that of the Ford Motor Company can afford to undertake so far reaching a development.

Only a few years ago, Ford engineers sought to substitute moldings of soya-phenolic plastic for such mechanically simple steel parts as interior garnish moldings for windows. The experiment reached a semi-production stage, but it was found that the plastic moldings were often cracked in assembly, and this resulted in abandoning the project.

A similar experience was encountered with a thermosetting plastic part of medium size on an instrument panel of another car. Although a change to a stronger grade of plastic helped matters, the company engineers considered results unsatisfactory and reverted to die cast or steel parts.

Some forms of plastic are brittle, and even when lightly stressed, may give trouble from breakage. Certain plastics are less brittle, but more expensive and may present difficulties in molding.

Most of the frame and the drawer of this register are plastic moldings, although appearance rather than lower cost dictated the change

Still other plastics, though easily molded, are subject to warpage, shrinkage or cold flow. If the part is fairly large, the plastic must be fastened to metal to provide strength and to avoid warpage. However, when the plastic is carefully chosen and applied with due regard for its properties, it often can be substituted for metal. Ford has substituted several acetate-butyrate moldings, especially for instrument bezels in the place of zinc alloy die castings with savings in weight and possibly finishing cost. The parts, however, are designed for molding and are not duplicates of the die castings.

There has been almost no substitution of plastics for die castings in external applications, partly because the plastics are deficient in strength and few of them are suited for outdoor exposure. Where a shortage of zinc has forced replacement of external parts heretofore die cast, the substitute has, in general, been steel. Plastics which withstand outdoor exposure are usually expensive. Such use as they have attained in outdoor service are mostly those for decorative needs or where a transparent or translucent material is essential.

3. Availability of Plastics

Precise data on the production of plastics in 1939 are not available, but estimates range from 160,000,000 to 250,000,000 lb., much of which probably was used in paint and similar products. In the same year, steel production totaled 81,210,000,000 lb. Aluminum production is given as 327,000,000 lb. and zinc production as 1,252,000,000 lb. About 168,000,000 lb. of zinc alloy die castings were produced in 1939. All these figures have increased since 1939, but although the total production of plastic in relation to total metal production is small, it was considerable in relation to that of aluminum in 1939. Any large increase in the application of plastics in place of either zinc or aluminum, if it can be made, might release a considerable proportion of these metals for other uses. For zinc alloy the chances of large scale substitution are not promising. The chief uses of zinc are in galvanizing, as an alloying element with copper to produce brass and in die casting.

Demands for brass are pressing, and it is difficult to see how any potential use of plastics can affect them significantly. The steadily increasing output of zinc and the drop in automotive demand for zinc alloy die castings (brought about by suggestions of OPM) may result in relieving the present stringency in zinc, more or less independent of any effect which plastic applications may have.

Suppose, however, that feasible ways are found for extending the application of plastics to ease certain short-

ages in metals, especially aluminum. Will the plastics then be available in sufficient quantities to affect the defense economy favorably or will the increased demand for plastics then merely create another stringency? There has been no significant shortage of the raw materials needed for plastics manufacture except perhaps the supply of formaldehyde which one plastic producer, at least, is reported to have encountered because equipment for making this important chemical had been converted to other uses.

On the other hand, at least one of the major plastics producers is reported close to capacity output, and it is likely that others may be nearing that point since demands for plastics are understood to be at an all-time maximum. Doubtless there is still some slack in the production of some plastics, but if demand is boosted greatly it might not last long. New capacity could be created, but how soon? Or would it be justified? Here one faces the question of availability of chemical equipment, much of it costly and not quickly produced. Some of it requires the use of pure nickel or high nickel alloys which are affected by the existing shortage of this metal.

Any plan for an extensive substitution of plastics for metals should certainly include a study of the probable future supply of the plastic required before commitments are made. This is especially true in the case of molded plastic products which often require a large investment in mold.

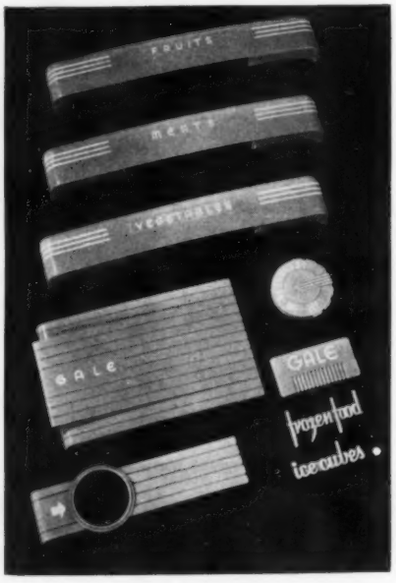
4. Labor Supply Required for Plastic Utilization

Those experienced in molding frequently say that almost every new molding involves difficulties which cannot be foreseen. Plastics vary in their properties not only in different materials but in different grades of the same type. Aging and moisture content often affect the molding material. In short, it requires care, skill and experience to insure good results in plastic molding and these have to be acquired. It is not always easy to secure experienced plastic molders, and when they are not available, any plans for extensive molding should include consideration of what may be involved in training them. The same applies to those charged with set-up and maintenance of molds and equipment.

The design and production of molds for plastics requires skill which is still more difficult to acquire than that needed for using the molds once they are made. Diemakers are scarce, and those with experience in producing plastic molds are not numerous. Most of them are with plastic molders whose business is booming and who consider it essential to have their own men and facilities; relatively few die shops have men of required experience.

5. Equipment in Relation to Plastic Production

Many forms of plastic products can be cut from sheet, rod or tubular stock or from extruded plastic shapes by the use of simple machines such as are used for metal or wood working. However, molding is often the most efficient way to use plastics, and when molding must be done, equipment is needed. Recently a maker of automotive accessories found that a partial



Lightly stressed or largely decorative parts, such as these for domestic refrigerators, are being produced in polystrene where aluminum or other sheet metal was formerly used

conversion to plastics would require some six months to install the necessary molding equipment and that this equipment would take more room than die-casting equipment for the same total output, because the molding cycle is slower than the die casting cycle.

Makers of molding presses and molding machines are behind in deliveries, much as are makers of machine tools. Common compression molding presses require supplementary hydraulic equipment (although many self-contained presses are now offered) and a supply of steam, hot water or electric current for heating and curing the plastic. Rapid production often necessitates multiple cavity molds which usually demand large presses, but even then production rates may be less than for stamping, die casting, forging or some other method of production.

Frequently, however, the plastic part requires no applied finish, although fin removal and sometimes polishing may be necessary. This may or may not be offset by higher material cost.

Plastics can be worked with about the same economy as metal products and sometimes with greater economy, but any shift to plastics requires that the equipment to fabricate it must be found somewhere. If it is not available, it must be secured and delay is involved. The question of investment in relation to the rate of production and over-all return must be considered.

6. Customer Acceptance of Plastics

Advertising and publicity given plastics plus inherent merits of the materials themselves have done much to gain customer acceptance for plastic products. However, if performance is inferior to that of the material displaced, this will soon be discovered. This substitution may be countenanced on the score of saving other materials for defense uses but may mean treading on dangerous ground so far as the manufacturer's reputation is concerned.

Customers were not pleased with attractive plastic knobs on automobile instrument panels when these knobs were found to pull off easily (either because of cold flow in the plastic or because of an inadequate fastening). This led to a considerable return to die cast knobs in 1941 cars. Some makers of refrigerators are reported to have substituted plastic for aluminum ice trays, because of the shortage of aluminum. If the trays crack or break easily or if their lower heat conducting capacity results in too slow a freezing rate, results may not prove encouraging. Apparently, the public is pleased with the substitution of a plastic inner panel for refrigerator doors, as this saved some space, and low heat conductivity is an advantage.

* * *

Can plastics replace metal? Plastics can replace metals under certain sets of favorable conditions, most of which have been named. They cannot do so at all in some cases and not with assurance of satisfaction in many others. In a normal economy, plastics can take the place of metals only where they provide either a product of lower cost or a balance of advantages not realized more cheaply by some other means. In a defense economy, certain artificial factors enter to change the picture, but in the long run plastics are likely to be chosen only for those applications in which their inherent qualities make them cheaper or better for a given purpose.

Natural Sag of Test Mandrels

BY DR. GEORGE SCHLESINGER, THE INSTITUTION OF PRODUCTION ENGINEERS, LONDON, ENGLAND

II—Elimination of errors due to the natural sag of mandrels is possible when all test results are based on correct methods

ONE OF THREE METHODS can be used for testing the alignment of horizontal axes. These are the "swing-around" method shown in Fig. 12, the "double-mandrel" method shown in Fig. 13, and the "slip-bushing" method shown in Fig. 15.

The swing-around method, Fig. 12, requires a dial gage of reasonable accuracy and a mandrel, preferably hollow, of any convenient size. Readings are taken 180-deg. apart, so that half the difference between them gives the error between the two axes. The gage can be checked for backlash and accuracy of dial divisions by using slip gages. If the gage has the required accuracy, the accuracy of this method depends only on the rigidity of the stand.

In general, the gage stand has joints which are tightened on a sliding fit by nut and screw. The stand elements are bars of various lengths and limited diameters subject to change of position by incorrect handling. Further, any errors in the bearings of the main spindle of the machine will affect the readings. These are the principal objections to the use of a movable dial indicator, and are reasons for replacing the swing-around method by one employing stationary indicators and measuring from a fixed reference plane, as by the two-mandrel method shown in Fig. 13.

If, however, the stand on which the dial indicator is fastened does not deflect because of the weight of the indicator, and the pressure of the spring which actuates the feeler, and by changing the position of the gage during measuring, all of these objections are eliminated, and the method can compete with any other procedure. A tube stand of simple but effective design is shown at *B* in Fig. 12. Devised by the Research department of the Institution of Production Engineers, this stand has been found to give good results with a 0.0001-in. dial gage. Errors are in the range of 0.00004 to 0.00007 in. and less for 8 to 12 oz. weight of indicator plus pressure of spring. These limits are permissible for all swing-around method measurements which may occur during the acceptance testing of machine tools. Calculated deflections for the tubular support shown at *B* in Fig. 12 when made from a 12-in. long steel tube having an inside diameter of 3.19 in. and an outside diameter of 3.5 in. and a weight of 4.84 lb. are as follows: deflection of free end of tube due to its own weight, 0.00000883 in.; added deflection due to 0.92 lb. weight of supporting arms at outer end of tube, 0.0000045 in.; added deflection due to weight of dial indicator plus a plunger pressure of 8 oz., 0.0000024 in.; total deflection of structure, plus deflection with 8 oz. plunger pressure, 0.0000157 in. When using a dial indicator having a plunger pressure of 12 oz., the additional deflection is only 0.0000012 in. Practical tests have shown that such a tube is extraordinarily rigid and that the above deflections have a negligible effect on the final results.

Double-Mandrel Method

In the double-mandrel method of testing the alignment of horizontal axes, as shown in Fig. 13, a carefully centered mandrel on the main spindle

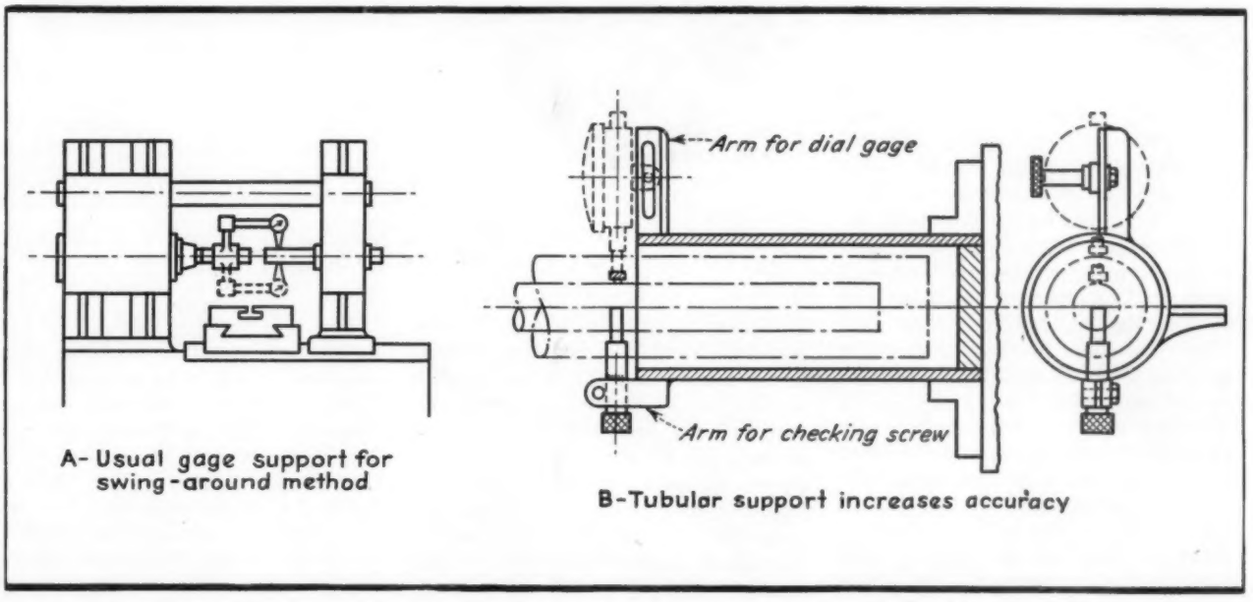

Arm for dial gage
Arm for checking screw
A- Usual gage support for swing-around method
B-Tubular support increases accuracy

Fig. 12—Principal objections to the swing-around method of testing the alignment of horizontal axes, shown at A, *develop because of lack of rigidity of the gage holder. A tubular holder like that shown at* B *gives excellent results*

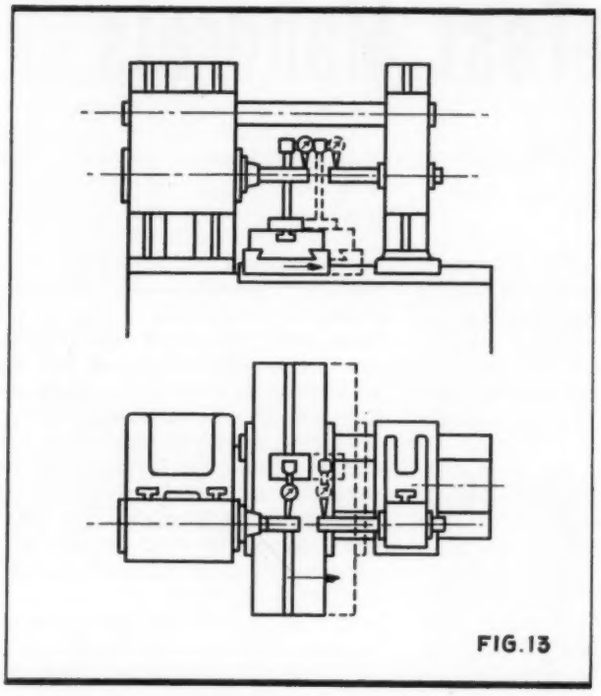


Fig. 13—A large number of test mandrels are necessary where the alignment of a number of different machines is to be tested by the double-mandrel method

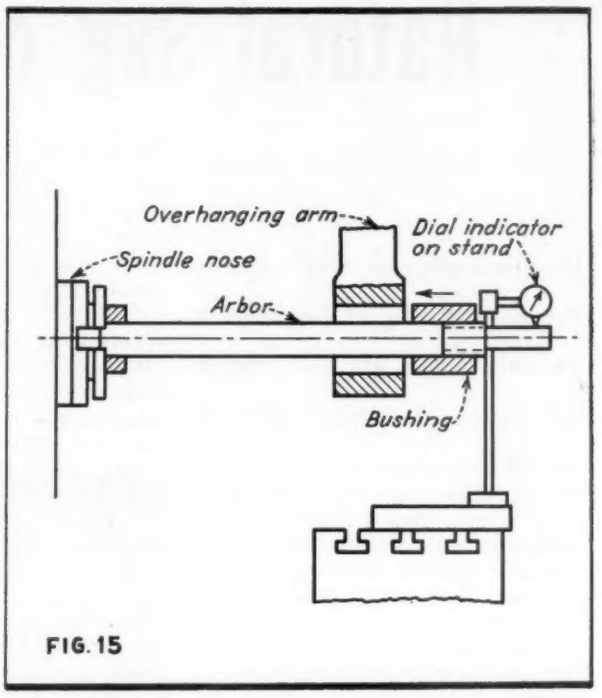


Fig. 15—Commonly used to test the alignment of milling machines, the slip bushing method is rapid but is subject to inaccuracies

of the machine is compared with another mandrel of exactly the same diameter on the opposite machine component. This may be a turret head or an overhanging arm. In this test a dial indicator fixed to some suitable base is moving in a fixed plane, such as on a lathe carriage or a milling machine table, to obtain the comparison readings. The mandrel on the main spindle sometimes must have a large flange welded to the cylindrical testing section. The flange must be suitable for the spindle nose of the machine to be tested, and may be cylindrical, tapered, or a combination of both. Thus, a large number of special mandrels must be available when inspecting the alignment of spindles on machine tools.

There are further disadvantages. Since the mandrels are opposite each other, and each should be 12-in. long to fulfill the test conditions, there must be a clear space of more than 24-in. between the main spindle face and the surface supporting the second mandrel. The fact that the two mandrels may have different natural sags also must be allowed for in the computations. The main spindle mandrel must be checked for eccentricity and both mandrels arranged so that their axes coincide with their axes of rotation in the planes perpendicular to those in which readings are taken.

Finally, the mandrel must fit the spindle nose of the machine centrally.

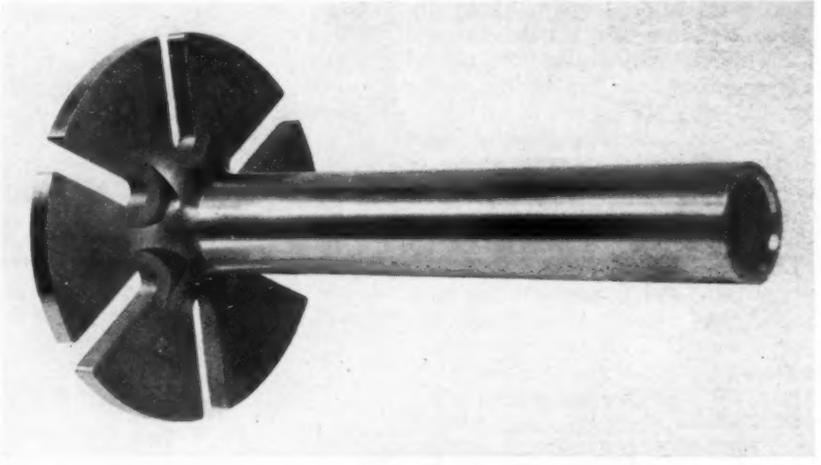


Fig. 14—The Whitehouse special test mandrel has a number of advantages when using the double-mandrel method

However, the main spindle dimensions may vary within the permissible tolerance. Hence, the flange on the test mandrel must be made to the high size, and will not be a sufficiently precise fit on a spindle nose made to the low limits. To avoid this, the mandrel must be made with six bolts to allow final adjustment until its axis coincides with the axis of rotation of the spindle. This is not an easy operation. The Whitehouse test mandrel shown in Fig. 14 has six radial slots to make accurate setting easy, and is hollow to avoid unnecessary sag.

The slip bushing method is commonly used on milling machine, taking an arbor known to be accurate and in good condition as the test mandrel. The test is made by taking clock readings in the position shown in Fig. 15, then moving the bushing into the overhanging arm and repeating the readings, thus determining the amount by which the arbor is strained from its free position. This method has the advantage that it can be done quickly, and that dial indicator is stationary. However, it has several important disadvantages. The arbor must be very

accurate and run true, since it has to be turned during the test. Any errors in the main bearing affect the results, as in the swing-around method. Thus these errors must be measured beforehand to determine the mean position, so that they may be allowed for in the actual test.

Errors between the axes of the spindle and the arbor are due to: (a) incorrect taper, (b) eccentricity, (c) lack of truth, and (d) deviation from cylindrical shape. The arbor itself is generally long relative to its diameter, so that the natural sag is comparatively large. This sag can be diminished if a hollow mandrel is used, but this is a special instrument which cannot be represented by an ordinary milling machine arbor. Such arbors usually have a cutter keyway, therefore the dial indicator must be applied to the short cylindrical part at the outer end.

Similar objections arise from the use of the bushing itself. It must be fully concentric and cylindrical internally and externally, and must be a good sliding fit on the arbor and in the bracket. Also cast iron bushings are heavy, weighing between 2 and 4 lb. depending on the machine, and bronze bushings are still heavier, so that the increase in the sag of the mandrel will be considerable.

Tools of this difficult type may be useful in the hands of the maker, but they are, in the majority of cases, not suitable in the hands of the user, since a great variety of non-standard mandrels, brackets, bushings and main spindle noses, demand such a variety of tools, that the method could only be recommended if the entire industry were to standardize the dimensions of all these components.

Hydraulic Hints

THE INCREASING application of hydraulic drives to machine tools has made necessary exact knowledge of this type of equipment by shop men. Those responsible for care and operation of hydraulic machinery should find the following hints helpful:

Keep oil up to required level. Lack of sufficient oil in the system will result in noisy operation and lack of positiveness in the drive.

Use only oil recommended by the manufacturer. Oil must be free of moisture, acids and other corroding substances. Too heavy oil produces gum formation and results in sluggish action because of too much fluid friction, which in turn causes heating and loss of power. Life of unsuitable oils is short, and the cost of reclaiming or recharging is higher than necessary.

Drain oil frequently if machine is in constant use. Some units require complete drain and refill every three or four months unless oil is automatically filtered and tested periodically. In the latter case clean out oil filter at regular intervals. Be sure to keep cutting lubricants out of the fluid power system and away from the fluid power pump reservoir.

Never flush out pumps or systems with anything but good clean oil. Kerosene, gasoline, or similar liquids should not be used.

Don't use dirty containers to convey oil from the barrel or source of supply to the fluid power reservoir. Grit, dirt or other foreign matter must be kept out of oil to prevent scoring of accurate working surfaces of pumps and valves. Use a clean strainer when filling reservoir. Always keep reservoir tightly closed to all chips and foreign matter.

Don't allow air to stay in system. Foam on the tank and jerky feeds indicate presence of air. If oil has been kept at proper level and suction and inlet pipes are far enough below oil surface, check filter, fittings and valves for possible leaks. When filling the system, entrance of air can be reduced by adding make-up oil slowly and straining it through several thicknesses of cheesecloth. After filling, any entrained air will gradually work its way out if the pump is run for a short time. Running time is less for light than for heavy oil.

Turn pump shafts by hand, after pump and system have been refilled or have been idle for a time, to be sure that working parts are free. Turn motor control off and on several times before pump reaches full speed to be sure that lubricating oil reaches the closely fitted parts.

Don't draw packing up too tight as added friction destroys the efficiency and timing of the hydraulic system.

Handle all parts carefully when repairing valves or pumps. Slightest damage to the accurately made parts may impair efficiency or accuracy of operation. Some pumps operate only one way and care should be exercised in their re-assembly.

Provide air breathers or cleaners on units when large differentials are used, or when air in the shop contains foreign particles which are detrimental to the fluid power system. If necessary, extend the breather connection to another department or outside the plant.

Before assembly, clean all piping thoroughly. If standard welded pipe is used it should be pickled to remove all inside scale, then thoroughly washed to remove acid. Carefully burr both inside and outside of pipe to remove all sharp edges or loose particles of metal that might possibly get into the line. Be sure tubing is thoroughly cleaned of saw and file chips or other foreign matter which might cause damage to the hydraulic equipment.

Use only dies in A-1 condition for threading tubing, as the amount of leakage depends primarily on the quality of thread fit, particularly at the higher pressures. At screwed joints that are not brazed, tinning the threads on the external pipe and adding a coating of thin lacquer is of some assistance in making a tight joint. Litharge, shellac, and similar materials are of little value, particularly at the higher pressures.

Make up all pipe lengths and fittings accurately so they will fit into position without straining. This helps prevent leaky joints which cause loss of power.

Use only the best welders if screw joint between tubing and fitting is to be brazed for additional protection against leakage, as pipes can be easily damaged beyond the benefits gained by brazing. Brazing should be very carefully performed to prevent overheating or unequal expansion. Improper brazing will crack the tubing at the root of the thread. Heat the fitting slowly and evenly. Direct the flame against the fitting rather than against the wall of the tubing. Heating should not be carried beyond the point at which the rod will flow properly. Use sufficient material to fill completely all the exposed threads and produce a smooth fillet in the joint so that stress concentration will be eliminated.

Don't make bends too sharp. Use suitable dies which will prevent collapse of tube. Filling with sand is a simple way of bending tubing without collapsing the walls if no other tools are available. Care must be exercised to remove all sand before assembling pipe into system.

Welding by Sub-Assemblies

BY R. W. FISHER, NATIONAL RUBBER MACHINERY COMPANY

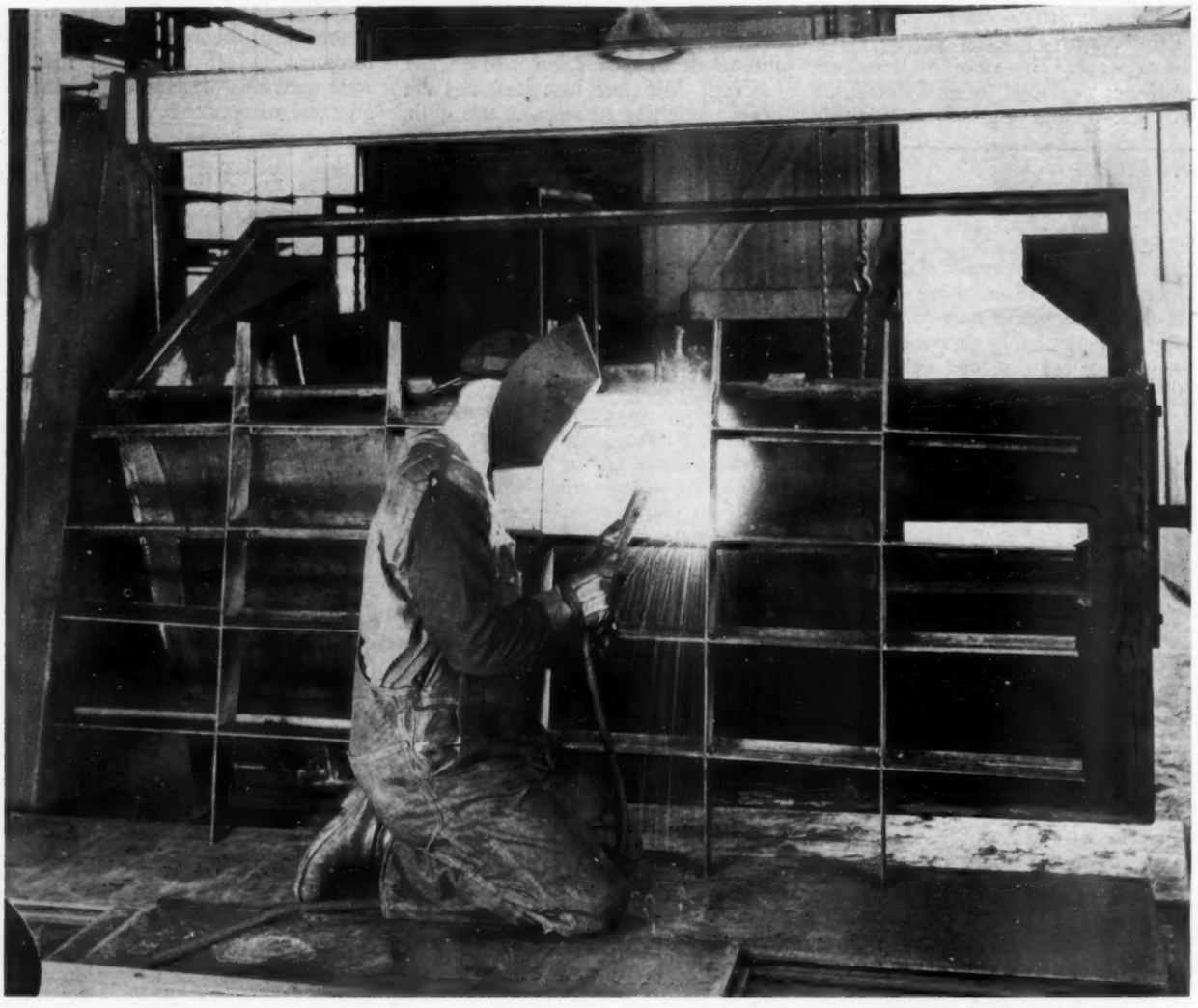


Fig. 1—For the upper platen, a continuous fillet weld is made at each joint between the longitudinal spacer and the crosspiece of the tack-welded gusset-plate sub-assembly

Distortion, long a problem of no mean proportions in many welding shops, can be minimized when design and procedures are co-ordinated as in this plant

FROM EXPERIENCE gained in arc-welding several hundred vulcanizers, National Rubber Machinery Company has reached the conclusion that fabricated structures are ordinarily 20 per cent cheaper than cast ones. Vulcanizers are large box-like structures that require a number of brackets, internal reinforcements and pads. It is difficult and often impossible to attain the same thinness of wall sections by casting as by welding. Consequently, weight savings afforded by fabricated designs may reach 50 per cent, which is an important factor in reducing floor loading in customers' plants.

Welded fabrication was commenced at the Columbiana, Ohio plant in 1937, but difficulties were immediately experienced with distortion. Standard analysis plate with 0.20-0.30 per cent carbon buckled badly from the effects of welding heat. After consultation with steel companies, it was decided to use SAE open-hearth tank-quality plate that is rolled for flatness while still warm. Certain specifications are placed on the chemical and physical properties of this material. Carbon is held between 0.14-0.18 per cent, preferably 0.16 per cent; phosphorous to a maximum of 0.04; sulphur to

0.05, and manganese to 0.30-0.45, since this percentage of manganese has been shown to promote good welding properties. Tensile strength is 60,000 lb. per sq. in.; elongation, 30 per cent.

Despite selection of a material that is inherently low in distortion, it is still necessary for the welding shop to determine suitable methods and the proper sequence of operations for each job. The object of these steps is to control distortion so that straightening can be done without "popping" the welds, and to bring the structure to over-all dimensions required by the customer, or by the adjacent machine shop so that machined surfaces can be cleaned up with a minimum degree of effort.

Accumulated experience along these lines is depicted by fabricating methods employed for dual vulcanizers supplied to the Ball Band plant of the United States Rubber Company for the production of sponge-rubber automobile seat cushions. A seat-cushion vulcanizer consists of a welded base, which includes a reinforced box-like lower platen that contains the molds, and a reinforced upper platen that opens back by means of a motor-drive operating through linkages in the welded end housings. In considering the entire job, the welding shop must choose methods that will (1) control distortion of the main sub-assemblies so that they will fit together to form a steam-tight mold cavity, (2) resist the load of the molds and internal steam pressure.

Procedure Minimizes Distortion

The top platen resembles a coffin lid and measures 84 in. long by 40 in. wide by 8 in. deep. This structure is internally reinforced by a gusset-plate assembly. Fabricating procedure represents an evolution of methods designed to minimize distortion, and is typical of steps used in vulcanizer fabrication.

1. A rectangular frame for the bottom sealing faces is produced by clamping 1½x2 in. bar stock to a surface plate and fillet welding the joints.

2. A bottom plate is tack welded to the bar-stock frame at 6 in. intervals, using about one-third of a rod at each weld.

3. The gusset plate sub-assembly is produced separately. Five flame-cut crosspieces are spaced apart by five longitudinal rows of short flame-cut members. Each spacer has an angle iron previously welded to the top edge to act as a stiffener.

The spacers are tack welded to the crosspieces while resting on a surface plate or table. This assembly is then stood upright, as shown in Fig. 1, so that the operator can most conveniently run one continuous fillet weld at the joint between spacer and crosspiece. It is not necessary to weld both sides of the joint to attain sufficient structural strength. Furthermore, welding both sides would create too much stiffness for straightening.

4. The gusset plate assembly is blocked up on the surface plate of the straightening equipment, as shown in Fig. 2, and the ends are purposely pulled down ⅛ in. relative to the center. This intentional bowing counteracts the opposite distortion that occurs when the gusset plate assembly is welded to the frame and bottom plate.

5. The gusset plate assembly is positioned on the bottom plate and frame and is tacked welded to these two members. End plates and side plates are also tack welded to the frame and the gusset plate assembly. Finally, the bottom plate is continuously welded to the frame; likewise the end and side plates are continuously welded to the frame. The welded assembly is now distorted so that the ends are $\frac{3}{16}$ in. higher than the center of the gusset plate.

6. Annealing follows in a car-type furnace, and but no further distortion occurs.

7. Straightening is easily accomplished with a 20-ton "Porto Power" hydraulic jack, which is used in connection with a heavy channel-iron frame mounted above a surface plate.

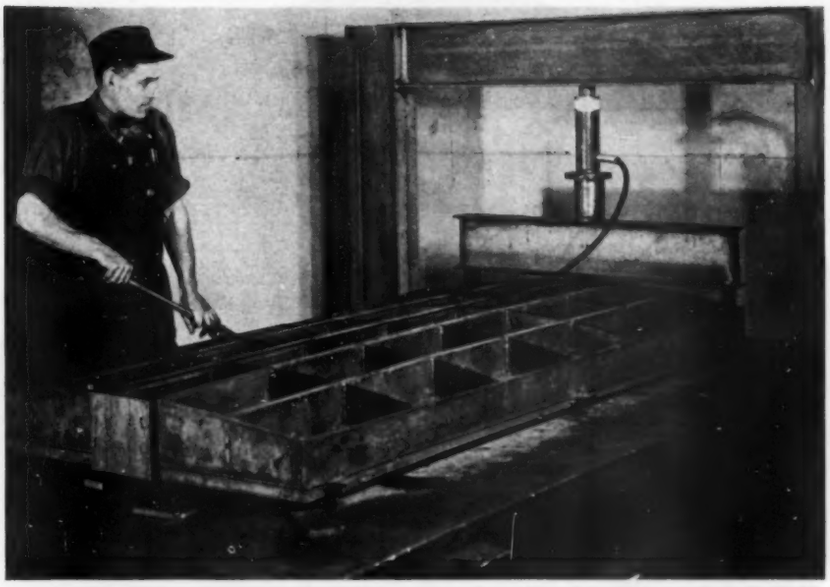


Fig. 2—A home-made straightening equipment, consisting of a surface plate, a channel-iron frame and a hand-pumped 20-ton "Porto Power" hydraulic jack, facilitates straightening such structures as the upper platen for an automobile seat-cushion vulcanizer

The lessons learned by the welding shop are as follows: (1) When the gusset plate assembly was built up piece by piece on the frame and bottom plate, the assembly bowed so that the ends were ¾ in. higher than the center, (2) annealing of a structure welded in this manner induced an additional bowing of ¾ in., making a total of 1½ in., (3) it was impossible to straighten the assembly without breaking the welds.

The present method of making up sub-assemblies and leaving continuous welds until last minimizes distortion. Furthermore, annealing does not affect the welded assembly. The top platen is thus easily straightened so that only a light planer cut is required on the bottom surface of the frame in order to attain a proper seal. A sheet-metal cover is welded over the gusset-plate assembly after the honeycomb is filled with insulation. In Fig. 3 the welder and a helper are tack welding a pad previously positioned by a layout man.

Tire-Mold Vulcanizer

From a welding standpoint, the Ford dual tire-mold vulcanizer sketched in Fig. 4 presented several difficult problems in respect to control of distortion, such as: (1) holding the over-all dimensions to $\frac{1}{32}$ in., (2) welding brackets *A* into the end plates without undue distortion, (3) securing parallelism between the keyways in brackets *A* and the long keyway *B* in the front top edge of the vulcanizer base, and (4) maintaining a close

Fig. 3—Pads and built-up brackets are positioned on the vulcanizer base by a layout man, after which a welder and helper join the parts to the base with short intermittent fillet welds

tolerance for spacing of the vertical guides *C*.

Assembly of the vulcanizer base, which resembles a box with an open top, was carried out in a jig set-up on a surface plate. This jig included several heavy uprights with hinged clamp attachments that permitted reaching inside the vulcanizer base to hold the partially fabricated brackets *A* and the guides *C* while tack welding. The job was completely spotted in the jig and the inside beads were run in the bottom. A shrinkage of $\frac{3}{16}$ in. in 90 in. was allowed for in the jig, to bring the box-structure to correct over-all dimensions.

Brackets *A* were produced as sub-assemblies because distortion could not be controlled or overcome when the individual parts were successively welded into the end plates of the base. These sub-assemblies were produced by welding the two gussets *F* to the top plate *G*, which bowed as shown by the dash line. Annealing the bracket removed practically all of the bowing. This assembly without the keyway plate *H* was spotted into the vulcanizer base while in the main assembly jig.

The base was removed from the jig for finish welding. Then it was annealed and the top surface machined, including the long keyway *B*. The next step was welding a keyway plate *H* to each of the two brackets *A*.

It was a requirement of the dual vulcanizer that the upper platen close firmly on the machined top surface of the base and rest firmly upon plates *H*. Furthermore, keys on the platen must enter the keyway *B* and the keyways in plates *H*. Practically a four-point bearing was required, and therefore it was essential to use an accurate jig to locate plates *H* on brackets *A*.

The heavy channel-iron jig located from keyway *B* and established the height of plate *H* with respect to the machined top surface within minus 0, plus 0.0010 in. Plate *H* was fastened to the jig by four screws, since two were found insufficient. Plate *H* was continuously welded along all four edges to the plate *G*. The keyway plate showed a tendency to pull down 0.020 in. as a result of welding. Consequently, this tendency was overcome by shimming the jig.

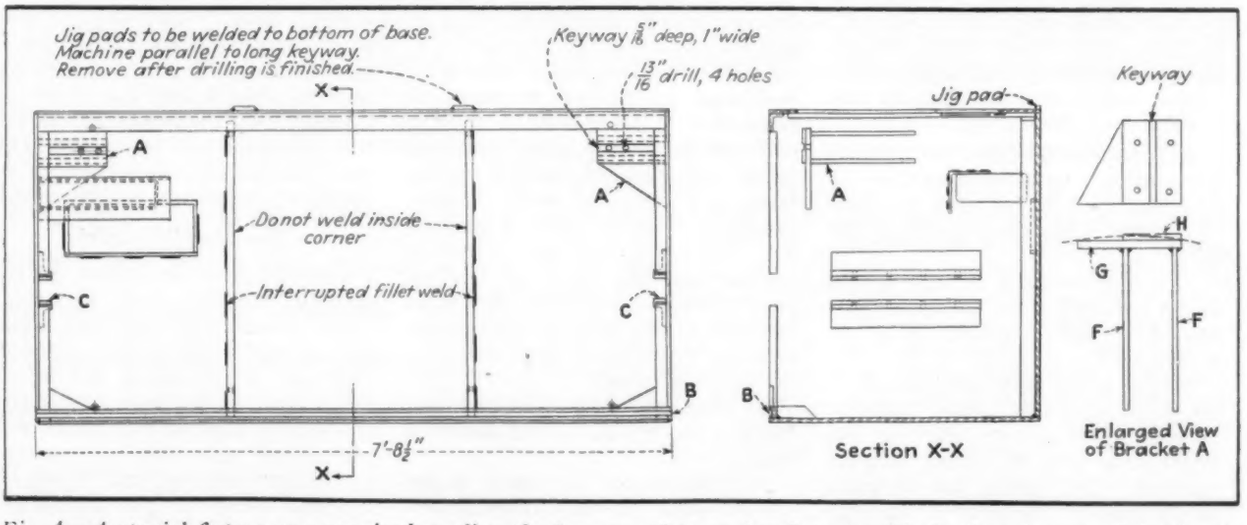


Fig. 4—A special fixture was required to align the keyway plate on brackets A *with the long keyway* B *in the top front edge of the Ford tire-vulcanizer base*

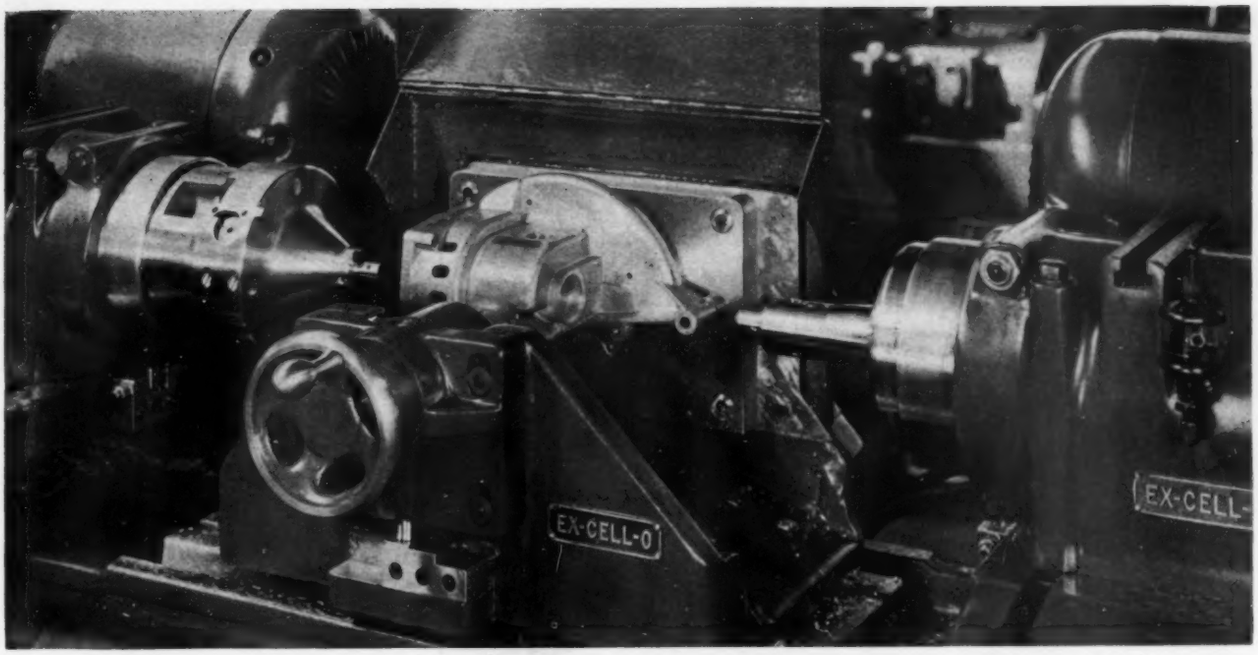


Fig. 1—Both facing and boring this aluminum die casting are performed simultaneously on this machine

Precision Boring—Plus

BY G. D. STEWART, CHIEF ENGINEER, STANDARD MACHINERY, EX-CELL-O CORPORATION

Maybe your machine tools are capable of more than you give them credit for. It's a good idea to consider their use on cuts other than the obvious ones

CERTAIN MACHINE TOOLS, which can perform a variety of operations, suffer mental limitations because of their commonly accepted names. Some engineers and production men have a tendency to limit the production of automatic and hand screw machines to the production of screws and that of keyseaters to keyseating. They also restrict drill presses to drilling, and punch presses to punching operations only. Milling machines, planers, boring mills, frequently are mentally held down to milling, planing and boring operations respectively. These machines, however, can and do perform a variety of additional operations of particular importance when it is not possible or practical to obtain a single-purpose machine for the work.

The condition applies to precision boring machines, which, as will be demonstrated, perform a number of operations in addition to boring. In the performance of these additional functions, outstanding production records and economies have been realized. In many instances, two, three, four and five operations can be accomplished at one time.

Some time ago, one of our representatives came to us with a rather intricate problem involving the boring, facing, turning and chamfering of a brass aircraft gyro part.

In common with all aircraft work, tolerances on this part are extremely close. Diameters must be concentric and faces square within close limits.

This job is now being performed on a production basis with satisfactory results. With the proper setting of tools, all limits and other requirements are automatically obtained; in addition to the fact that production costs have been materially reduced, interchangeability is assured and the necessity for frequent inspections has been done away with.

Aluminum die castings (Fig. 1), formerly bored and faced on three hand screw machines, are now precision bored and faced on two precision boring machines with production savings of from 66⅔ to 87 per cent in machining cost. Savings in inspection and on the assembly line also are realized.

In the same plant, the rear housings of portable electric saws are bored, counterbored and faced on a single-end precision boring machine. This machine is equipped with a belt-driven spindle and cutter head on the bridge, and a hand-operated fixture on the table. Holes 4.030 and 1.180 in. are bored, a diameter of 4.375 in. is counterbored and a 7⅞-in. diameter face is swept in one setting of the work. A limit of 0.0005 in. is consistently held on the 1.180-in. bearing hole.

Also in the same plant, a single-end precision boring machine has been set up for additional jobs, such as boring bearings and turning the outside diameters of steel rollers for belt sanders. These rollers, formerly bored and

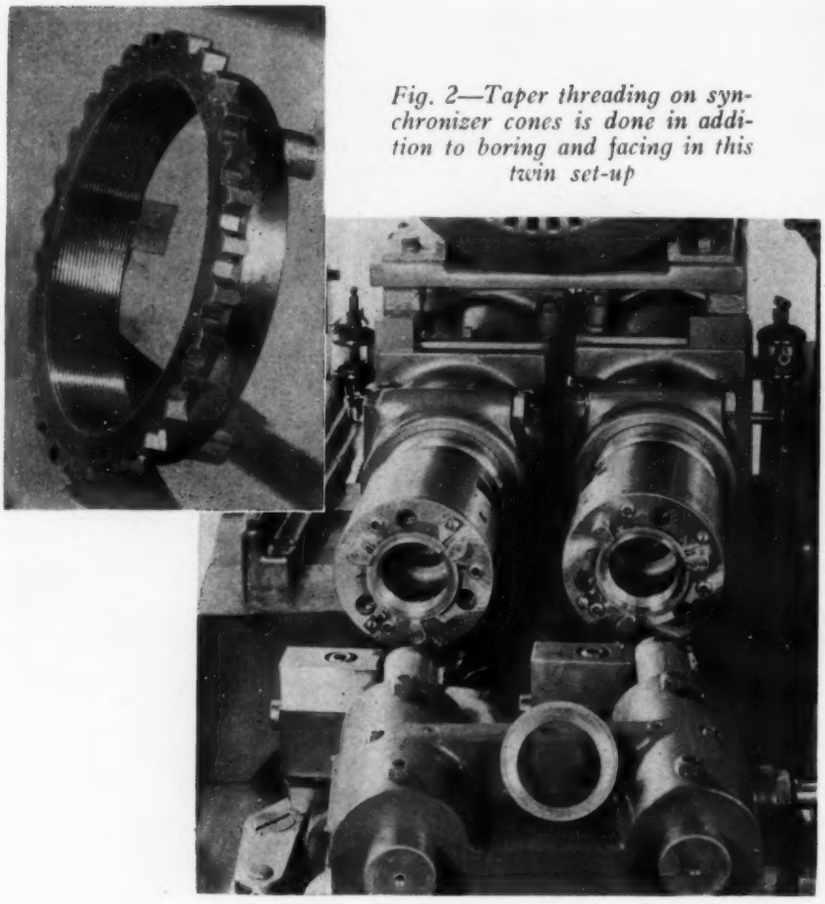


Fig. 2—Taper threading on synchronizer cones is done in addition to boring and facing in this twin set-up

turned on a hand screw machine and then ground, are now precision bored and turned; the final grinding operation has been eliminated.

Another multiple operation is the facing, boring, rough and finish taper threading and finish boring of two synchronizing cones on two spindles in one cycle (Fig. 2).

Two of these identical brass parts are placed in two finger chucks on the machine and located from the chamfered teeth on the outside diameter. Following the first facing operation, and on the return stroke of the single cycle, the parts are bored and rough and finish taper threaded. Crests of the threads are squared off as shown. These left-hand threads are 40 pitch with an inside diameter limit of plus 0 minus 0.002 in. Threads must present a uniformly corrugated surface on the inside of the part in order to assure wide distribution of surface without much contact. Flats at the crests of the threads must be uniform and held to a width of 0.003 in.

The two spindles are geared together. At the proper point in the return cycle, a nut drops down to engage a leadscrew which governs the 40 pitch threads that are cut simultaneously in the two parts. Production is approximately 250 pieces per hour at 80 per cent efficiency, for the two spindles.

Fig. 3—Solid and micrometer heads are used for boring, counterboring, chamfering and facing the aircraft engine rear case and master connecting rods

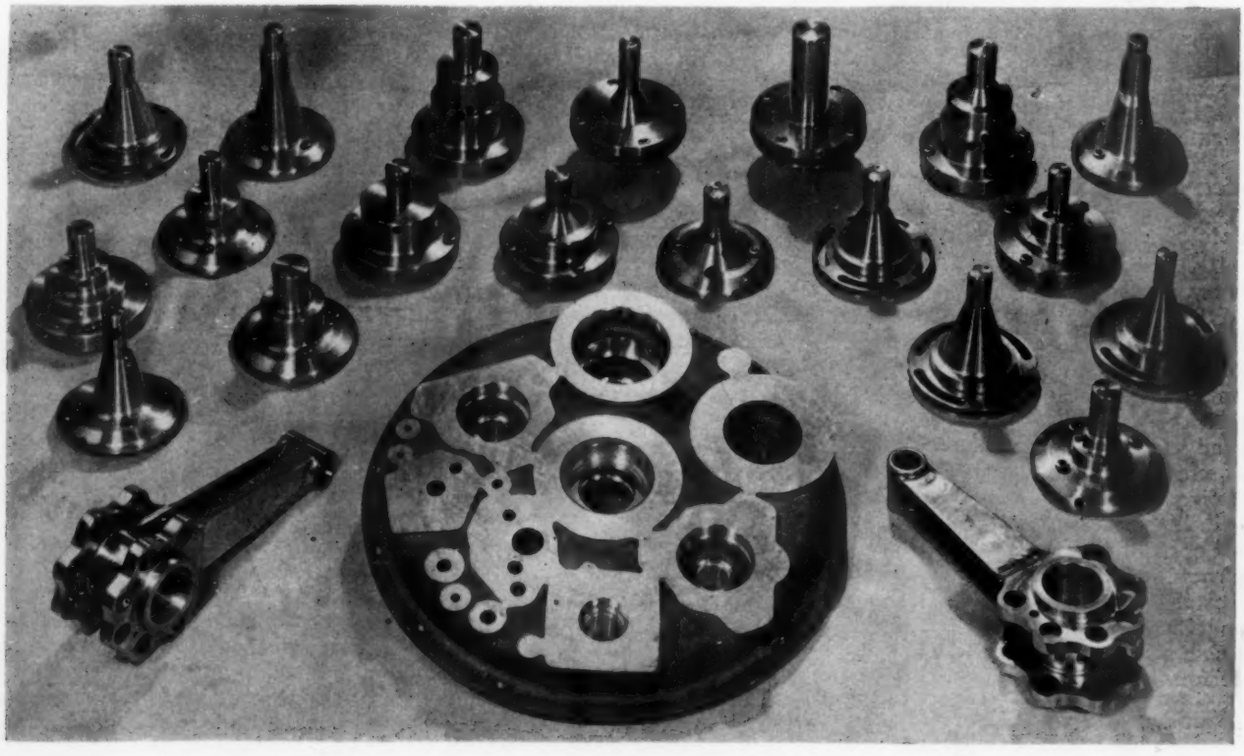


Fig. 3 shows the various boring, counterboring, chamfering and facing heads used for the operations on two vital parts of an aircraft engine. All of this work is done on one standard precision boring machine, equipped with two dovetail slides built in the bridges, two specially built work-holding fixtures and nineteen solid and micrometer adjustable boring quills.

The magnesium rear case contains eight precision bored holes and bushings which require eighteen operations, each one of which is individually performed in the vertical frame fixture (Fig. 4). Both holes in the steel connecting rod are finish bored simultaneously on the fixture shown in Fig. 5. Because of the nature of these parts, center distances between bored holes must be held to extremely close limits and surface finishes in all cases must be exceptionally smooth.

In order to produce the required accuracy of center distances in the rear case, the fixture is equipped with a master plate. This plate contains holes accurately ground to the correct center distances called for by the part. As the fixture is reset for each hole or bushing, an indicator is attached to the spindle and the spindle alignment checked with the corresponding hole in the master plate. The bridge slides provide lateral adjustment whereas the indexing plunger socket on the master plate allows vertical adjustment, so that the centering of the spindle and hole may be accomplished speedily and accurately.

The part is then clamped on the master plate, located by flatted plugs which engage reamed holes in the part. This procedure guarantees the exact relationship of the part and master plate of each successive loading. The result is the production of holes with exceedingly close tolerances on the center distances.

Adjustable Tools Used

All holes on the same radius are bored consecutively, thus eliminating unnecessary lateral adjustment of the spindle at each setting. The entire lot of parts is run through for each hole, at one setting of the machine. After the holes in the case proper are bored, bushings are pressed into the bored holes. The part is again loaded into the fixture and the bushings bored in the same manner as were the holes in the case. Suitable boring bars or quills with micro-adjustable tools, are furnished for each hole size. The fixture is so arranged that the part may be machined from either side.

The second fixture shows the rearrangement of the same machine used for boring both ends of the master connecting rod. The spindle, previously used on the right hand bridge is placed on the left hand bridge behind the front spindle so that both rod holes are bored from the same end of the machine. Both spindles are equipped with micro-adjustable quills.

The large end of the rod is supported on a double V-block with a ratchet type hand clamp and equalizer jaw applied from above. The small end is located by a retractable flatted plug. A fixable spring jack supports the small end and a similar ratchet type clamp screws it. The locating plug is then withdrawn by the hand lever at the right of the fixture and the part is ready for the double boring operation.

Fig. 6 is a four-station piston processing fixture, mounted on a senior-type, double-end precision boring machine. Two operations on this lynite piston are performed simultaneously at each end of the machine.

At the right end, the front station faces the spherical radius of the piston while the rear station faces the top and turns the ring grooves. At the left end of the machine, the front station turns the outside diameter while the rear station bores the piston pin hole.

The method of clamping the parts in position on all three turning and facing stations is identical. The piston skirt fits over an adapter plug and against

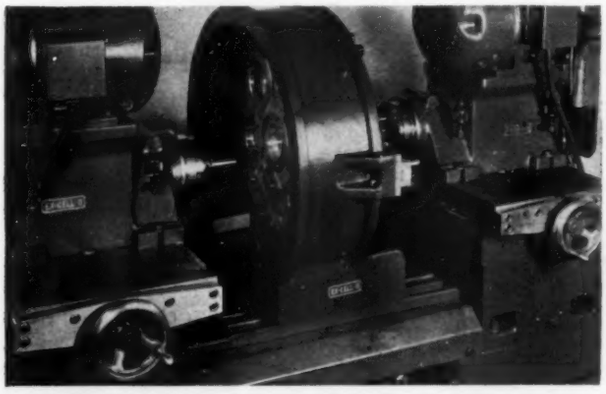


Fig. 4—Eight precision holes, requiring eighteen operations are done on the magnesium case in this boring machine set-up

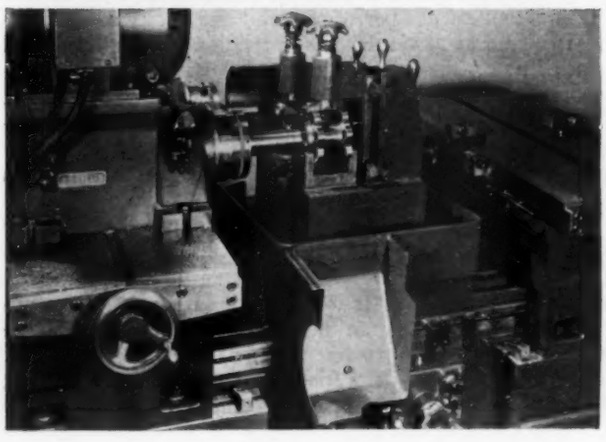
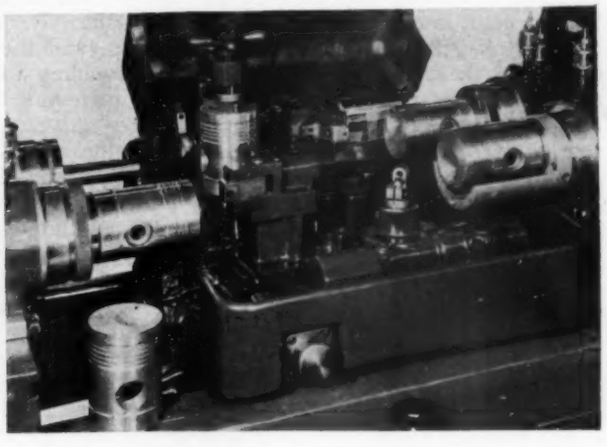


Fig. 5—Using the same machine as in Fig. 4, one boring head is transferred to the opposite end for operations on the connecting rods

Fig. 6—Four successive steps on a lynite piston are performed in this machine. They include forming the spherical recess, facing the top and cutting the grooves, turning the O.D. and boring the pin hole



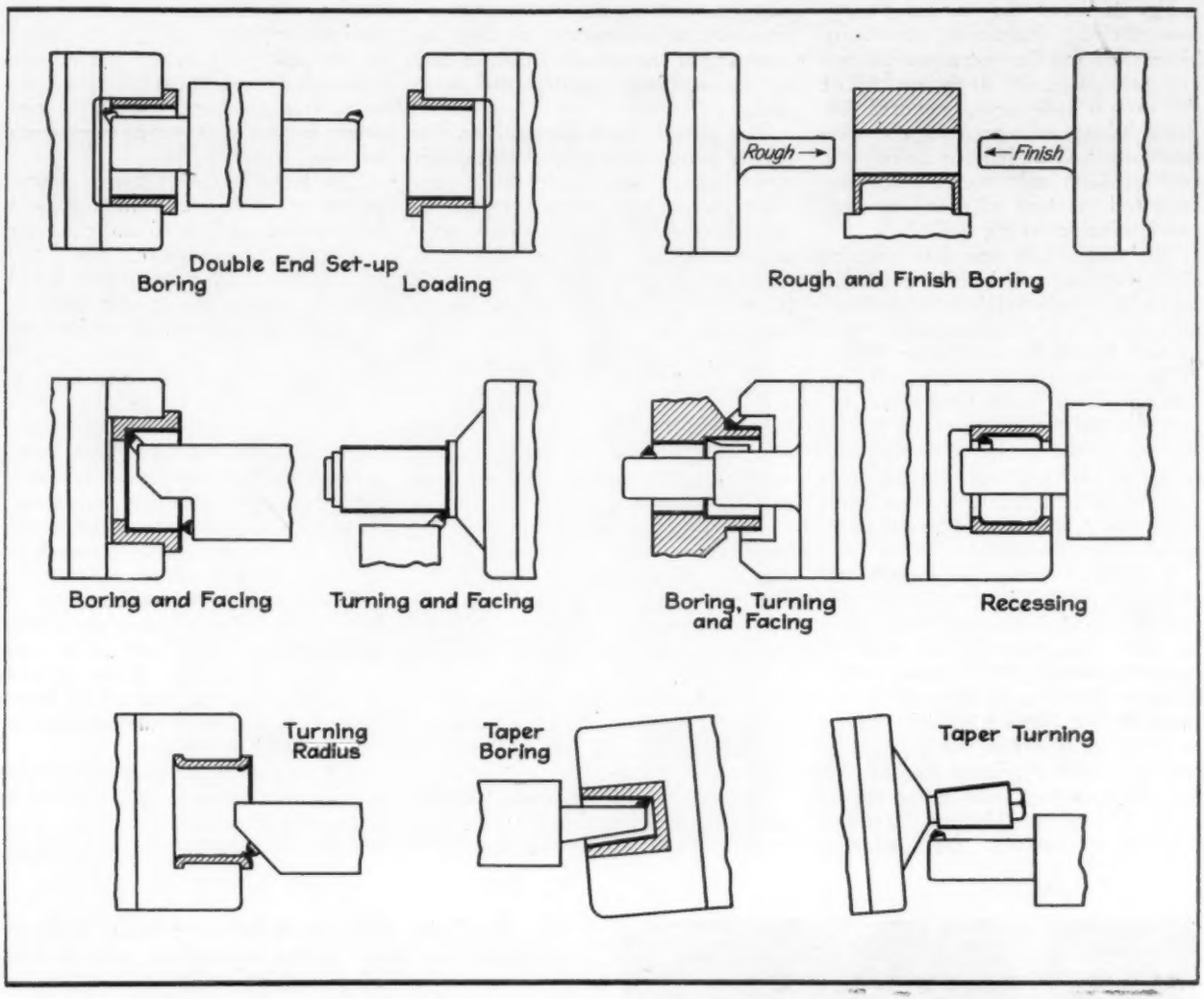


Fig. 7—Typical set-ups demonstrate the ways in which the work and tools may be arranged for a variety of operations, singly or in combination, on a precision boring machine

clamping surfaces on the chuck plate. A pin is inserted through the piston and draw bar eye, which, actuated by a hydraulic cylinder through the spindle, clamps the piston securely in position on the chuck.

At the boring station, the piston is vertical with the skirt over a locating plug and on the clamping surfaces. A locating pin is inserted through the pin hole and two retractable locating arms, operated by the knob in front of the fixture, are brought to bear against it. The hand-operated equalizer-jawed clamp secures the piston from above. The locating pin is then withdrawn and the locating arms retracted. A micro-adjustable type boring quill is used to bore the pin hole.

On the outside diameter turning station, left front, the tool is mounted in a hydraulically operated retracting toolblock which permits the return of the table without causing a drag-back line. The spindle is mounted on the bridge at the angle necessary to produce the required taper on the outside diameter.

At the right, rear facing and grooving station, the facing tool is mounted in a similar hydraulically operated retracting toolblock. The facing and grooving tools are mounted on a common hydraulically operated feed slide. Grooving and facing are completed simultaneously. The facing tool then retracts, and the slide is withdrawn, thus avoiding a drag-back line on the face and leaving the grooving tool clear for the table return.

At the right front spherical radius turning station, the tool is mounted in a rotating block which is hydraulically operated through a rack and pinion with a resistance spring to eliminate backlash. The chuck is counterbalanced as the spherical radius is not concentric with the piston.

The machine control lever, seen in the foreground, permits the operator to trip the machine table to the right or left through the machining cycle and return it to the central position for reloading.

In addition to these multiple operations, Fig. 7 indicates additional applications successfully performed on this equipment, singly and in combination, in various metal-working plants. These sketches show the specific operations performed and the locations of parts and tools in relation to work heads and table fixtures.

In view of this variety of operations, and countless others that also are common practice in high production precision plants, it is obvious that the term "precision boring machine" as a description, fall far short of the ultimate possibilities and functions of these particular machines.

It is necessary to exploit the maximum possibilities of every available machine when a tremendous variety of parts for tanks, guns, shells and aircraft engines are required.

Armament

SECTION OF AMERICAN MACHINIST

LINE-PRODUCTION OF 3-IN. A.A. SHELL

HAVING MADE SHELL for the U. S. Army during the last war, it was not difficult for the S. A. Woods Machine Company to get into production recently on the 3-in. high explosive anti-aircraft shell. Of course, modern equipment had to be purchased and installed, conveyor lines arranged, and machine operators and inspectors trained, but the management had a working knowledge of most of the problems involved in shell production.

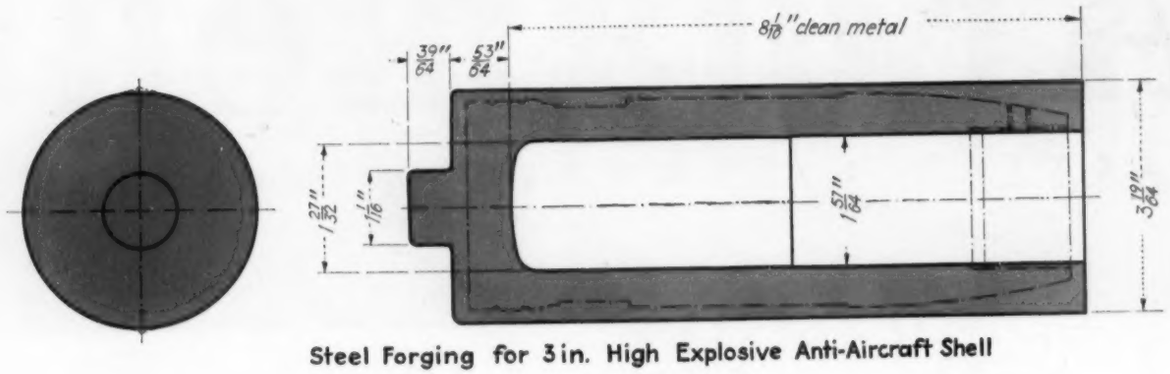
Of finish-forged-cavity design, the body for this anti-aircraft shell is forged from W. D. X1335 high-sulphur, high-manganese steel. Ordnance Department specifications call for this rough forging to have a maximum weight of 15.52 lb. The finished shell body, without band, base cover plate or setscrew weighs 9.28 lb. Total permissible weight of the finished shell body, including the band, the cover plate and the setscrew, is 9.79 $\pm$ 0.2 lb. The steel from which this shell is made has a minimum yield point of 45,000 lb. per sq.in., a minimum elongation of 15 percent in 2-in., and a minimum reduction of area of 30 percent. It is not necessary to heat-treat the shell body in order to obtain these physical properties.

It has not been found necessary to make physical tests of these shell in the machine shop, as the necessary tests are made at the forger's plant before the forgings are shipped. It is necessary, however, to make certain that forgings made from each "heat" of steel are kept separate. The forger stamps the heat number on the bottom of each forging, then this heat number is transferred to the body of the shell in the machine shop after the second rough turn operation, and after the finish turn operation.

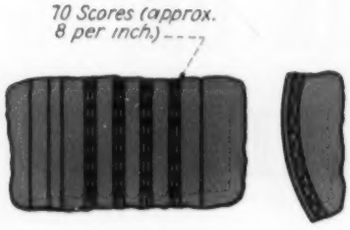
Shell forgings are received at the machine shop in freight cars and are stacked in the receiving room until needed by the production line. They are transported from the storage space to the shotblast machines on pin trucks which hold 25 shell each. These two-wheel trucks also were used throughout the machining line until spool-type roller conveyor lines could be installed.

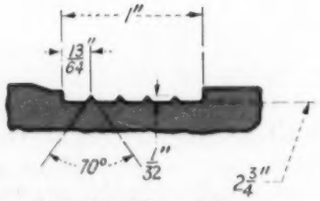
At the present time two double-spindle Model SSA shotblasting machines made by Gray Forgings & Stampings, Ltd., are used for cleaning scale and dirt from the forged cavities of shell bodies. These units hold the shell bodies vertically above nozzles, and rotate them at approximately 8 r.p.m. during the blasting operation. With one operator and a helper, from 700 to 750 shell forgings are trucked from the stock pile, shotblasted and delivered to the conveyor leading to the machine line each eight hours. Operation of these shotblasting machines is relatively simple, and little difficulty is experienced in keeping up the necessary production rate. The method of positioning shell in the Gray shotblasting machines is indicated in Fig. 1. The spindles operate independently.

Shell bodies delivered to the machine shop from the shotblasting machines first go to one of several Lipe special Carbo-Lathe shell centering machines, as shown in Fig. 2, where the forging is centered at the closed end and the open end is cut off and chamfered. On this and most other machining operations, the coolant used is a sulphurized oil mixed with water

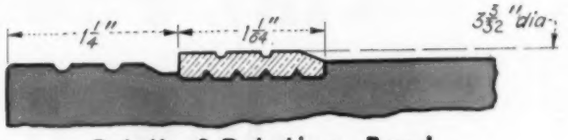


Steel Forging for 3 in. High Explosive Anti-Aircraft Shell

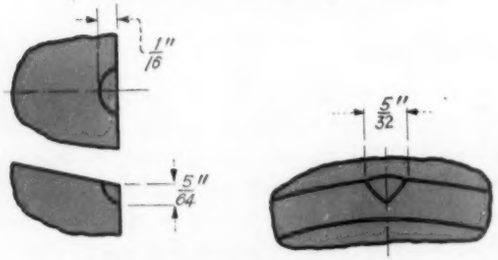




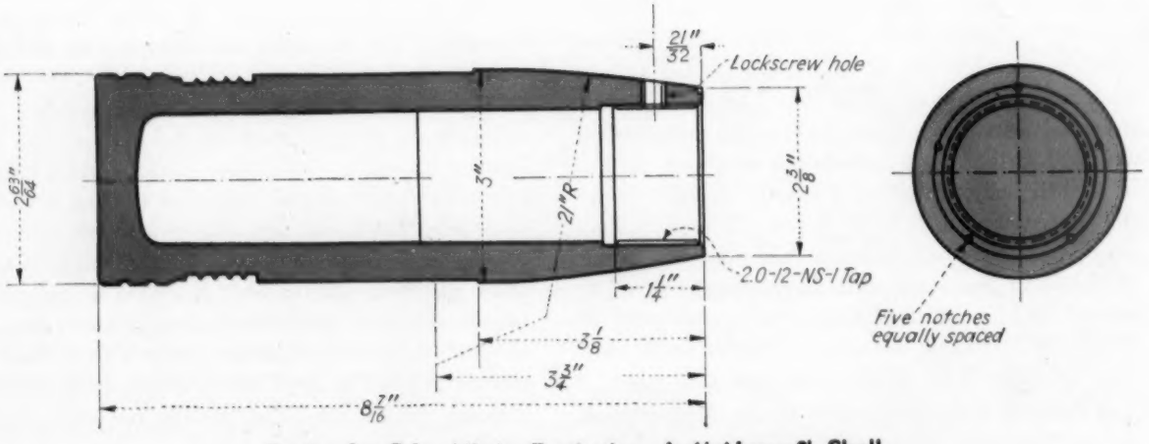
Detail of Band Seat



Detail of Rotating Band



Detail of Staking Notch



Body for 3 in. High Explosive Anti-Aircraft Shell

The 3-in. high explosive anti-aircraft shell is forged from W.D. X1335 steel. Maximum weight of the forging is 15.52 lb.; machined body weighs 9.28 pounds. Dimensions shown are only approximately equal to those specified on working drawings

in a 1 to 10 ratio. In the set-up shown for centering and cutting off the open end, the forging is held on an expanding arbor having three expanding tool steel jaws which grip the shell near the open end inside the cavity, and three expanding jaws which are held against the walls of the cavity near the bottom by spring pressure. In this operation the work speed is about 300 r.p.m. and the drill speed is 900 r.p.m. When not in use, the drilling spindle automatically is retracted to the rear of the machine to provide clearance for loading and unloading forgings on the work-holding arbor. Approximately one shell per minute is centered and cut off with this set-up.

At the end of the conveyor line in Fig. 2 is shown the shop inspector who removes burrs with a file and checks each shell before it is passed along to the next operation. This practice of having a shop inspection of each shell is followed after each major machining operation in the line. While expensive, it has practically eliminated rejections of shell by government inspectors at the end of the line. It also has the advantage of quickly discovering any improper tool settings, and relieves the machine operators of the necessity for individually gaging shell finished on their machines. Production, therefore, is kept at a high rate without permitting imperfect shell to pass further down the machining line before discovery.

Rough turning of the centered and cut-off shell forgings has been divided into two operations in order to lighten the load on the turning tools and so increase tool life. The first rough turn operation is done on a Blood special shell lathe with turning tools mounted on front and rear carriages. The open end of the shell is centered and driven on a splined, tapered driver, permanently mounted in the spindle of the headstock. The shell is held against this driver by an hydraulically operated live-center tailstock. After loading, the operator moves one control lever. This automatically starts the spindle and causes the tools to go through their complete cycle, then brings the machine to a stop. Hence, it is easy for one operator to take care of two of these

Fig. 1—Shell cavities are shotblasted in double-spindle Gray machines before delivery to the machining line. Each spindle has a separate control

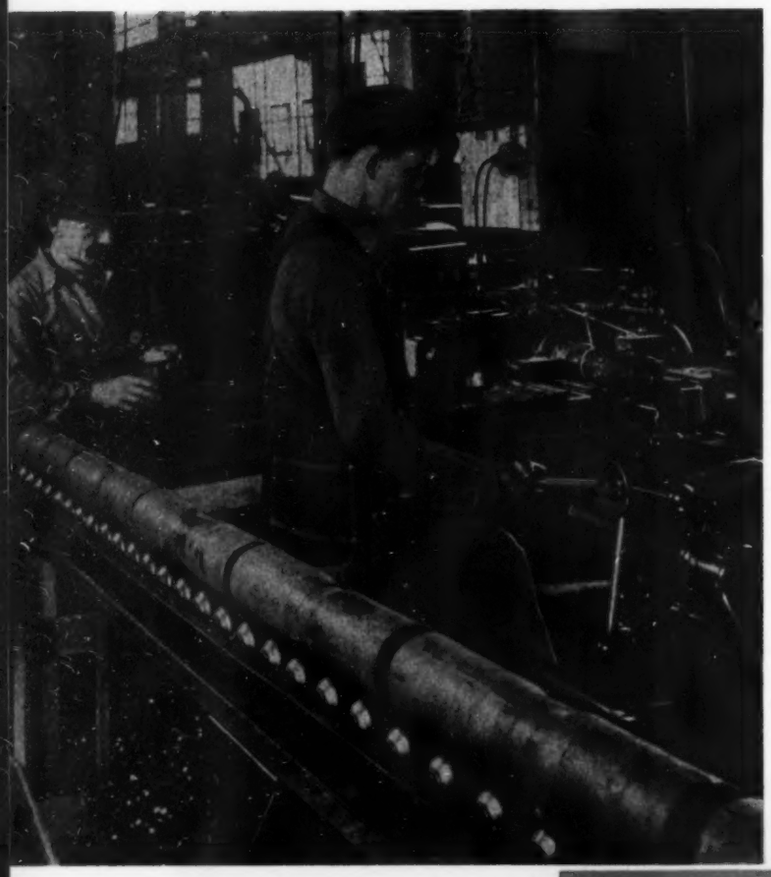


Fig. 2—Each shell forging is centered in the base end, and cutoff and chamfered at the open end in Carbo-Lathe shell centering machines. Note the spool-type roller conveyor line that delivers forgings from the shotblasting machines

machines. Using carbide-tipped tools, the work is rotated at a speed to give about 200 ft. per min. cutting speed with a feed of 0.040 in. per rev. Upon removal from the machine, the rough turned shell is placed on a conveyor line which delivers the forging to the second rough turn operation, which is shown in Fig. 3.

The second rough turn operation also is performed with carbide-tipped tools in a Carbo-Matic lathe at about 225 ft. per min. cutting speed. In this operation the base end of the shell body is faced and chamfered. Like the machine for the first rough turn operation, this machine has an automatic cycle once the start lever is operated. By reference to Fig. 3, it will be noted that three tools are supported in the front carriage for turning the body of the shell, while the facing and chamfering tools are carried in a tool block mounted on the rear slide.

Upon completion of the second rough turn and face operation, the shell body is checked for depth of cavity, body diameter and nose diameter by a shop inspector, whose work-bench is located beside the conveyor line which transfers the rough turned shell to the nosing press.

The open end of the shell is closed in slightly so as to provide sufficient metal for the threads in the

Fig. 3—Second rough turn and face operation on the 3-in. anti-aircraft shell body is performed in a Lipe Carbo-Matic lathe. The nose end is driven by an expanding arbor while the base end is supported by an hydraulic tailstock as shown

fuze seat. This operation is performed in a No. 307 Bliss crank press, using tallow as a lubricant. The nosing press is placed in the machine line, shell bodies being delivered to the press by the conveyor line from the second rough turn operation. The nosing operation is rapid, so the operator has time to gage each shell, as shown in Fig. 4, before it is passed along the conveyor line to the next operation. In the background in Fig. 4 will be seen the pin-type trucks used to transport shell forgings when there is a breakdown in the conveyor line. Each of these trucks holds 25 forgings and is so balanced that one man easily can move the truck from place to place.

After nosing, the shell body is delivered to a Blood shell lathe for boring, facing and chamfering the nose end. In the set-up on this machine, the work is held in an air-operated collet, registering endwise against the machined face of the closed end, and supported at the closed end by a spring loaded center. This assures holding the finished bore concentric and parallel with the cavity. The turret has a guide bar to assure alignment of the roughing and finishing bars. Each bar carries three tools: one for boring, one for facing and one for chamfering. The finish boring bar has a depth stop which controls the distance between the bottom of the cavity and the finish faced nose of the shell. Upon completion of this operation, the forging is placed on the inspector's bench, where the diameter of the bore, the chamfer and the over-all length of the shell are checked by a shop inspector.

Next operation in the machine line is the finish turn operation. This is performed in a Lipe 15 × 30 in. Carbo-Matic lathe with front and rear turning carriages. The open end of the shell is held by an expanding arbor, registering endwise against the finished face of the nose end. Each tool carriage is controlled by a separate cam bar, and the carbide-tipped tools on the front carriage turn the bourrelet and the body while the tool on the rear carriage turns the ogive of the shell. Production is speeded by using two rates of feed. The tools plunge cut to depth, then go into a fine feed while the bourrelet is being turned, then the feed rate is increased for turning the ogive and the body of the shell. Operation cycle on this machine is automatic, once the shell has been loaded on the expanding arbor and the tailstock advanced, the operator shifts a control lever and the tools rapidly approach the work, plunge cut to depth, go into fine feed for the bourrelet, then change to coarse feed for the rest of the cut, are relieved and then returned to the starting position

Fig. 4—The nose end of the shell forging is closed in slightly to provide metal for threads in the fuze seat. A No. 307 Bliss press is used. Nosing die is made of a non-scoring die steel

Fig. 5—After the finish turn operation, the ogive contour, diameter of the bourrelet, position of the bourrelet, body diameter and nose diameter are checked on each shell by a shop inspector

Fig. 6—Base end operations are performed in a Blood lathe having a hand-fed cross-slide. High-speed steel form and parting tools are used

Fig. 7—Five circular staking notches are milled in the nose end of each shell. A positive stop in the fixture base limits the travel of the slide to control the depth of each notch

where the machine automatically is stopped. A 20-hp. motor drives the lathe at approximately 225 to 275 ft. per min. cutting speed.

Following the finish turn operation, the shop floor inspector, Fig. 5, checks the machined surfaces carefully and then places the shell body on a conveyor line which delivers it to a group of Blood type grooving lathes where the band groove is form turned and the boss on the base end of the shell is faced off. This set-up is shown in Fig. 6. While carbide-tipped tools are used on practically all of the other machines in this shell line, high-speed steel form tools and parting tools are employed on these base-end units. Spindle speed is set to give a cutting speed of approximately 90 to 100 ft. per min., and the tools are fed by hand. The shell body is gripped on the outside diameter close to the band groove in an air-operated collet, registering endwise from the finished face of the open end. With tools mounted on the cross slide, the center boss is cut off within 1/64 in. of the closed end, and the band and crimping grooves are formed by reversing the travel of the cross slide. Upon completion of this operation, the shell again are checked by a floor inspector and then are delivered by conveyor to a double-wheel Gardner disk grinder. Here, the base end of each shell is ground to remove what is left of the boss and to provide a smooth surface to insure proper contact of the base cover plate. This operation is simple, the shell body being positioned in V-blocks on the swinging table and located by a stop.

Immediately following the disk grinder in the machining line is a pressure-testing unit, where the shell body can be immersed in a tank of water while compressed air is delivered to the cavity through a gasketed cover plate which effectively seals the open end of the shell. Originally, this test was applied to a fixed percentage of all shell moving through the machining line. However, this has been discontinued and the test is used only when the Government Inspector finds a shell whose appearance indicates that the body may be porous. In addition, a high-pressure hydrostatic test is available.

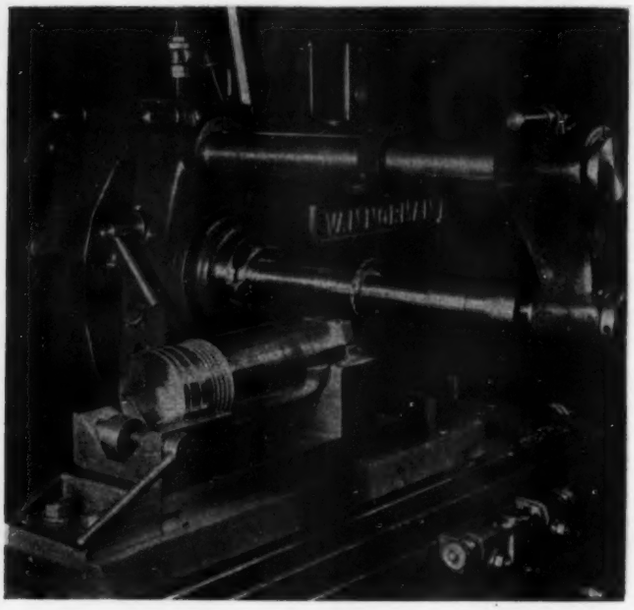


Fig. 8—Indexing of the shell to space the staking notches 72 deg. apart around the circumference of the shell is accomplished by aligning a previously cut notch with a notch in the fixture's stop plate before milling the next notch

Next, the grooves in the band seat are knurled in a standard Morley vertical machine. Original specifications called for knurling four notches per inch around the circumference of this band groove, and considerable difficulty was experienced in securing a good job. The specifications now have been changed to call for eight notches per inch and no trouble is experienced with the operation.

Five 0.15 in. wide notches are milled in the nose end of each shell at the outside diameter. These notches are spaced 72 deg. apart around the circumference of the nose end, and are cut with a convex 3-in. diameter milling cutter using the set-up shown in Fig. 7. Originally, the Van Norman hand miller purchased for this job was equipped with an indexing fixture which clamped the shell on the outside diameter of the body and was equipped with an index plate. Experience showed, however, that the operation could be speeded up by using a simple V-block fixture as shown in Fig. 8. The cutter is rotated to make a climb cut, thus holding the shell firmly against a stop on the front block during the cut. Further, this fixture is arranged to slide in a block on the table of the machine, which is locked in position. The fixture shown in Fig. 8 is equipped with a cam lock to hold the shell in position, but the operator has found that the cut is not sufficiently heavy to cause the shell to move, and it is necessary only for him to press against the end of the shell with his thumbs as shown in Fig. 7. He places the shell in the fixture, pushes it forward to cut the first notch, returns the fixture to the original position and turns the shell 72 deg. so that the first notch aligns with a notch in the stop plate at the forward end of the fixture. He then cuts the next notch and repeats the cycle. This is a rapid operation, and only one machine is required to take care of the 1,600 shell put through this line each eight hours. No coolant is necessary, as the cut is very light. A stop on the table limits the forward position of the slide, so that the notch is cut to a depth of only 0.06 in.

The next operation in sequence on these 3-in. anti-aircraft shell is the drilling and tapping of a lock-screw hole 0.66 in. back of the nose end of the shell, and perpendicular to the longitudinal axis of the shell. This is a 0.3125-18NC-2 tapped hole in which a setscrew later is inserted to hold the fuze assembly. Two Allen two-spindle sensitive drill presses are located near the shell conveyor line for this operation. One spindle is used on each machine for drilling the hole, and the second spindle has a tapping head. The sliding fixture used for this operation is similar in design to that shown in Fig. 8, except that a jig bushing is supported above the nose end of the shell at one end of the baseplate of the fixture. First, the fixture is indexed against the stop under the drill bushing, and the hole is drilled by hand feed. Then the fixture is indexed along the table of the machine to bring the drilled hole under the tap. A high-viscosity oil is used to lubricate the tap.

Landis No. 1½ L tapping machines grouped as shown in Fig. 9 are used for threading the fuze seat in the nose end of these 3-in. anti-aircraft shell. These 2.0-12NS-1 threads have a minimum major diameter of 2.0000 in., a pitch diameter of 1.9459 + 0.0106 in., and a minor diameter of 1.9098 + 0.0090 in. The fixture used on these machines comprises a work supporting cradle, a hardened and ground centering

bushing to support the nose end of the shell, and a hardened and ground female center at the rear, as shown in Fig. 10. This center is slidably in ailgnment with the center of rotation of the machine and is employed both to support the base end of the shell and to provide the holding action for the work during the threading operation. It will be noted that shell are delivered on a conveyor line to the center of the group, and then are threaded in one of the two tapping machines. Then they are placed in a wood rack from which an inspector removes them to his working position. Convenience of location of the tapping machines in relation to the conveyor line and the inspectors rack are indicated in Fig. 9.

In the fixture shown in Fig. 10, the pressure exerted by the pneumatically operated rear center is sufficient to lock the work rigidly in position for tapping. Both the front bushing and the rear centering bushing are ground accurately to size, and are in close alignment with the center of rotation of the machine. The special Style LT Landis collapsible tap used for this operation has internal ducts through which high viscosity oil is conveyed to the cutting edges of the ground chasers. The tripping collar on this tap also acts as a pilot to assure maintenance of close tolerances for alignment of the thread with the shell body. The collar is ground to a running fit in a pilot bushing located at the front of the fixture in which the shell is centered. Experience has shown that it is best to remove the chasers for sharpening after approximately 250 shell have been tapped.

The tapped shell is inspected carefully before it is sent upstairs for the final operations. In Fig. 11 is shown an interesting adaptation of a Rickert-Shafer friction-driven tapping unit for driving the plug thread gage used at this inspection station. A wood block on the table of this machine centers the shell nose in relation to the gage and the inspector operates a foot lever to run the gage in and out of the threaded nose by means of the friction drive. Inspected shell are placed in an inclined rack from which they are picked up by a conveyor for delivery to the degreaser on the second floor.

Two power-driven conveyor lines raise the shell from the inspection station on the first floor to a Detrex Model 325 degreasing machine on the second floor, as shown in Fig. 12. Here, the shell are given a final check for length, and then are placed open-end down in racks on a conveyor line which carries them through the vapor, spray, vapor stages of the degreaser. At the other end of this machine the shell automatically are delivered to chutes which lead to conveyor lines that take the shell to the banding presses.

The 1-in. wide gilding metal driving bands are pressed into position in the band grooves with West

Fig. 9—One operator takes care of the two Landis No. 1½ L tapping machines employed for machining the fuze-seat threads in the nose and of each shell

Fig. 10—The pneumatically operated fixture on the shell tapper has tapered bushings which center the piece accurately in alignment with the center of rotation of the tap

Fig. 12—Two conveyor lines deliver shell from the ground floor to a Detrex degreaser on the second floor

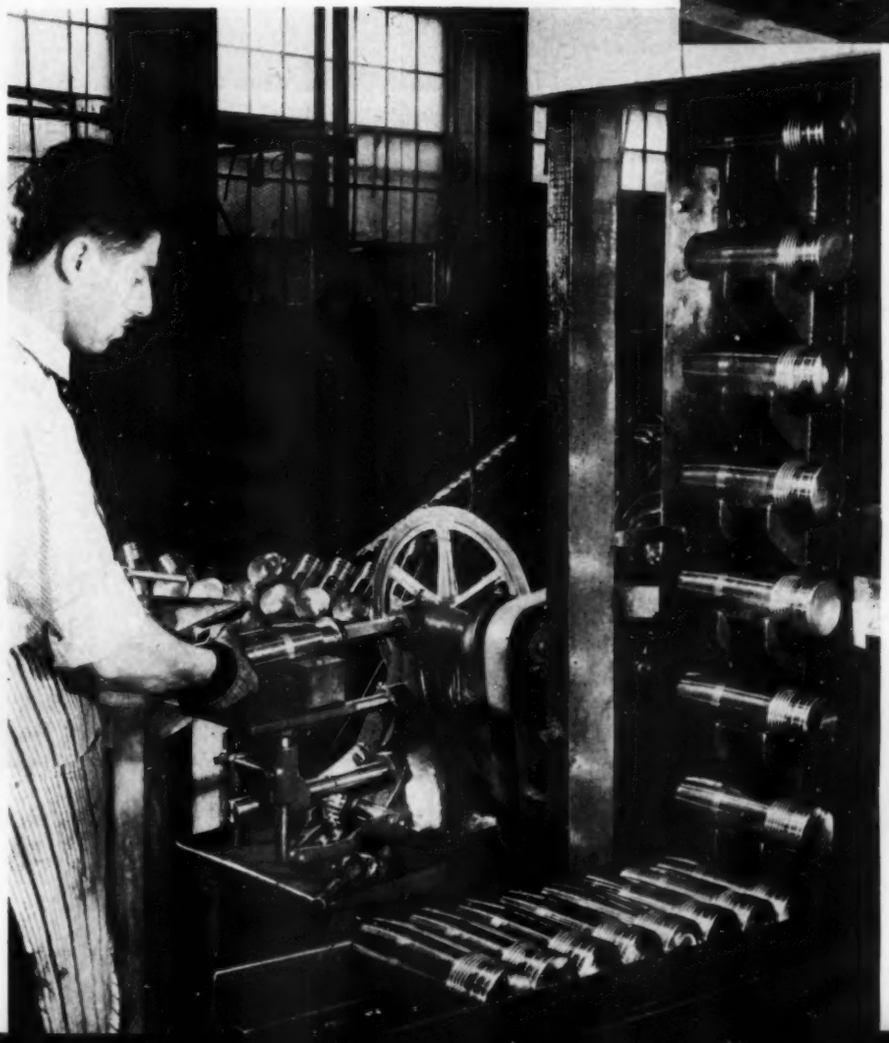


Fig. 11—The thread plug gage used for checking the tapped fuze seat in each shell is driven by a Rickert-Shafer friction head to reduce operator fatigue and increase production rate

Fig. 13—Shell on which the driving bands have been finish turned are transferred by conveyor to the final shop inspection bench

tire setters, then are delivered by conveyor to the group of three Blood band turning lathes shown in Fig. 13. Here the shell body is gripped in a collet chuck and located from the nose end. Using a high-speed steel form tool, the bands are finish turned and formed at about 300 ft. per min., using hand feed. Upon completion of the operation, the shell is removed from the collet chuck and placed on a conveyor line, see Fig. 13, which takes the shell to a bench for final shop inspection. Accepted shell are placed on another conveyor line, directly in front of the inspection bench, for transfer to the next station, where base cover plates are welded in position.

The set-up at this welding station is shown in Fig. 14. Here, one operator positions the shell bodies and cover plates in one of two National Type 100-PT-12 spot welders for attaching the plates to the base end of the shell by overlapping welds around the edge of the plate. The operator clamps the shell body in a fixture, then positions the plate on the base end with a gage and operates a control lever. This starts the automatic cycle of the machine, in which the weld-

Fig. 14—National spot welders attach cover plates to the base end of each shell with overlapping welds

ing head rotates about the edge of the plate, oscillating vertically between successive welds. As the cycle is automatic, the operator easily takes care of two of these 30-kva. machines. Finished shell then are placed on another conveyor line which takes them directly to the government inspection room. Some difficulty has been experienced because of the heat generated in the shell during the welding operation, and it is necessary to allow the shell to cool before they are checked by the Ordnance Department inspectors.

Inside the government inspection room each shell is given a 100 percent inspection by a crew of six Ordnance Department inspectors. Incoming shell are checked for weight, and the threaded nose end is checked with a unit similar to that shown in Fig. 11. Then the shell are placed in line down one or two inspection tables, and the crew of inspectors go over them thoroughly. Upon acceptance, each shell is stamped with an inspector's identification mark, then is placed on a conveyor line for return to the shop.

Just outside the government inspection room, accepted shell are marked with the necessary identification stamping in a Noble & Westbrook No. 4 marking machine, then are delivered by conveyor to the paint spray booth shown in Fig. 15. Here, each shell cavity is sprayed with an acid-proof ammunition black paint. Threads in the nose are protected with a metal shield slipped in place when the shell is positioned on the rollers in the booth. The spray gun is inserted to its full depth, the trigger is pulled, and the gun is slowly retracted from the cavity. Shell removed from the spray booth are placed in the cups shown in the foreground for drying. Each row of cups is on a conveyor bar of a special drying machine which is moved forward one position by power each time a line of cups is filled.

While the shell still is in a vertical position on the drying conveyor shown in Fig. 15, the next operator inserts a setscrew in the hole previously drilled and tapped near the nose end of the shell. Occasionally, it is necessary to retap this hole before applying the setscrew, and the operator keeps near at hand a tap and tap wrench for this purpose. Ordinarily, he will insert the setscrew in a full row of eight shell at a time. Then, he transfers this row of shell to a nearby work bench, Fig. 16, where masking tape is wrapped around the rotating band. In order to speed up this operation, a Spraco special taping machine is employed. This unit essentially consists of

Fig. 15—The cavity of each shell is spray coated with acid-proof black paint, then placed on a drying conveyor beside the Spraco paint booth

Fig. 16—Masking tape is wrapped around the shell at the rotating band after a setscrew has been inserted near the nose end

two shafts, one of which is driven by a small motor, on which are mounted rubber rolls to support the shell. A foot switch controls the motor so that the operator's hands are free to position the shell and apply the tape. Taped shell are placed base end down on the other end of the work bench, which is adjacent to the next spray booth as shown in Fig. 17.

At the end of the shell production line handling 3-in. high explosive anti-aircraft shell is a Spraco Model 743 paint booth having four vertical spindles which support and rotate the shell during the painting operation. This unit is shown in Fig. 17. A quick drying yellow lacquer is used on the outside of the shell, this being supplied from a pressure tank below the booth, shown immediately in front of the operator. Painted shell are removed from the booth to the drying conveyor seen at the right. Each slat on this conveyor has six posts, each with a rubber bumper at the bottom to protect threads in the nose of the shell when it is dropped over the post. This conveyor is moved forward one position each time the control pushbutton is operated. At the other end of the conveyor, which is approximately 6 ft. long, another operator removes the masking tape from around the rotating band and transfers the shell to a work table where heated grease is swabed over the fuze seat threads. Grease for this operation is kept in a pan placed on an electric hotplate, and swabbing is done with a paint brush. Completed shell then are packed in cardboard cartons, six to a carton, and then delivered to the shipping platform on the first floor by means of a helical chute.

Not only has each shell been checked after each major machining operation by a shop inspector, but it has been gone over thoroughly by the men in the Ordnance Department inspection room. It now is ready to be loaded with high explosive powder and fitted with a fuze and cartridge case. In addition to the Ordnance inspectors in the main inspection room, there is a floating force of Ordnance inspectors who travel back and forth along the production line to make certain that each operation is being performed properly. At least one of these inspectors is present when loaded cartons of shell are transferred from the shipping platform to the freight cars in which they leave the plant.

Fig. 17—Four shell are sprayed with yellow lacquer during each operation cycle in this Spraco booth. Finished shell are dried on the conveyor unit shown at the right

Powder Improves Radiographs

BY L. D. JENNINGS, WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

POSITIONING is an important factor when examining metal products with X-ray equipment, but when the object to be inspected has an area smaller than the negative, the operator must mask the unprotected film to prevent the secondary rays from over-exposing the outer edges of the picture. This may be done by placing sheet lead about the item, or by using powdered metal.

The latter method is more convenient and satisfactory, in that the powder easily may be placed about the castings, or may be used to fill any irregularity in the thickness of the part. This permits X-ray examination of the entire area of the part without blurring the outer edges of the picture. Either powdered iron or copper is a satisfactory material, with copper being preferred. The powdered metal should be a 40 to 200 mesh, with the finer mesh giving better results.

When using powdered metals in radiographing small, irregular parts it is advisable to place the part in a small tray, as in Fig. 1, and then fill around the part with the powdered metal. This method permits placing the assembly upon the cassette. It prevents flakes of the metal getting into the casette and upon the screens.

Fig. 2 shows a radiograph of two cast steel lifting lugs placed directly above the negative with no masking. The resulting film shows the centers of the castings, with the outer edges completely hidden by over-exposure from secondary rays. The X-ray picture in Fig. 3 is of the same two lugs made with identical power and exposure settings, but with 40-mesh copper powder surrounding the parts to mask the exposed film and to reduce the effect of secondary rays.

The exposed negative in Fig. 3 shows two distinct shadow pictures of the castings with sharp contour outline and uniform density. Imperfections in the homogeneity of the castings are indicated by the white areas in the photograph. The small crack at the tip of one of the castings is adequate proof that the adoption of powdered copper for masking the negative assist the radiographer when examining small parts.

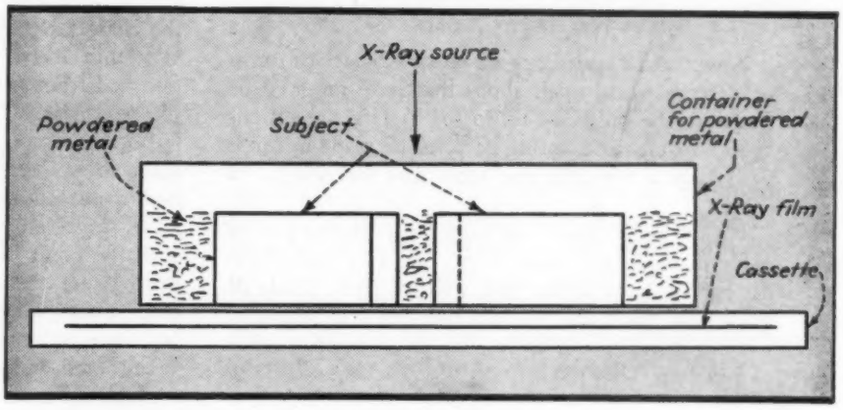


Fig. 1—A tray restricts the powdered metal to a local area, and keeps it out of the cassette

Fig. 2—Secondary rays cause over-exposure around edges of small parts

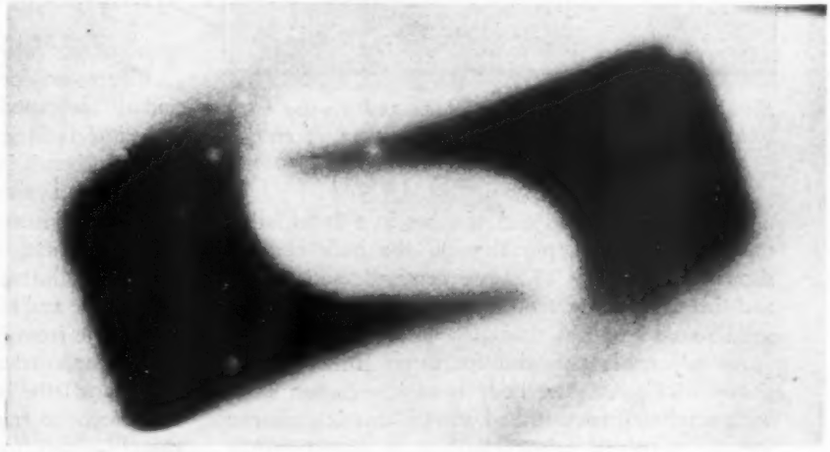


Fig. 3—Powder masks the film to reduce the effect of secondary rays

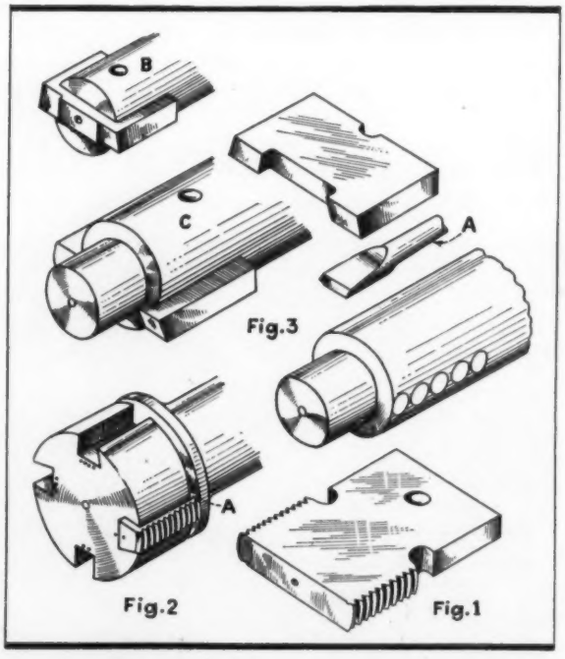
IDEAS FROM PRACTICAL MEN

Toolmaking in the Small Shop

BY FRED H. COLVIN

Now that all tool shops are busy with various forms of defense work, small shops that have never made tools may be called on to do so. A few suggestions as to how taps and boring bars can be made in shops with only a few machine tools may be helpful to some.

Figs. 1 and 2 show two forms of taps that can be easily made in any small shop. Fig. 1 is made from flat bar steel and works very well in brass. Made of stock $\frac{1}{2}$ in. thick, this will tap holes of 2 in. diameter without difficulty and up to 3 in. or more when made of $\frac{3}{4}$-in. bar. They require very little backing-off. They



Small shops can make these taps and boring bars quickly and economically when delivery of standard tools are held up by the defense program

are held in the slotted end of a bar in a turret lathe, or elsewhere, by a pin through the back end, as shown. The bar is of course centered, and turned and threaded in the usual manner as though it was a solid round bar.

An adjustable tap, also for turret lathe work is shown in Fig. 2. The body is of low carbon steel, with a relief groove turned at *A*. This is clearance for the shaper or planer tool used in cutting the slots, which are beveled, or half-dovetailed as shown. The chasers are easily made and are threaded as though they were solid. As the outer diameter wears the chasers are set out by putting liners of paper or very thin metal under them. The slots are prick punched from *one* to *four* and the chasers marked in the same way.

Boring bars, such as shown in Fig. 3 can be easily made in any shop having an engine lathe. The bar is first turned and then slotted by drilling in the lathe. Lines are scribed on opposite sides of the bar with the point of a lathe tool. Center holes for the drilling are then prick punched at the proper distance apart. With a drill in the lathe spindle and the bar centered by the punch marks on the opposite side against the tailstock center, the holes are drilled through the bar, reversing after the hole is half way through.

The thin walls between the holes are then cut out with a chisel. A cape chisel can be used but a chisel with a flat side and only one cutting angle, as at *A* is better for this work.

Another method is to drill the holes far enough apart to leave a wall of $\frac{1}{8}$ in. or more between them. Then plug the holes that have been drilled with soft steel rods and drill through the walls. The plugs in the holes will support the drill on each side. This leaves less metal to be chipped out; in fact, it can be filed without chipping in some cases.

In some cases the cutter is put in the end of the bar as at *B*. In others it is behind a pilot as in *C*. In *B* the cutter is both centered and held by the pin through the bar. In *C* the cutter is centered by projecting each side of the pilot and held by a slightly tapering pin at the back.

Centerpunch Aids Bench-Lathe Indexing

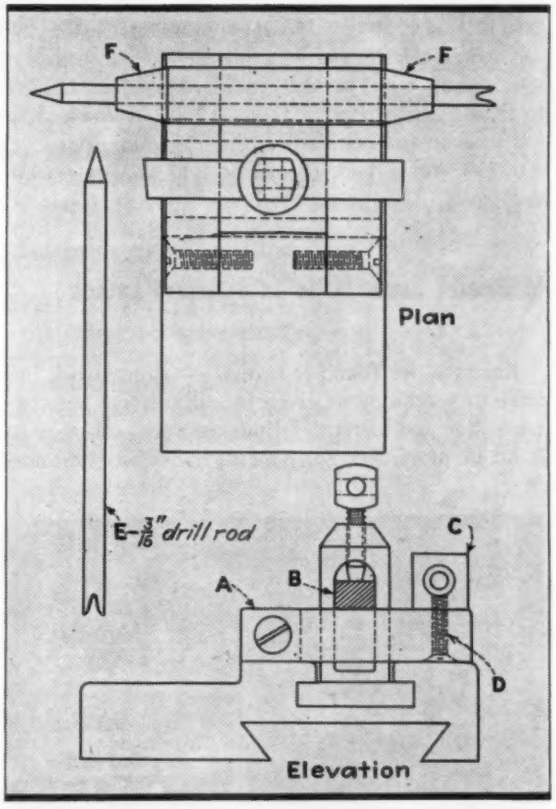
BY LAURENCE F. SOUTHWICK

Where one does not have access to a dividing-head and its associated equipment, or in cases where the indexing facilities provided in most of the better makes of bench lathes are insufficient for the purpose, the indexing centerpunch illustrated will prove invaluable. It consists of a rectangular base *A* set on top of the toolrest, and held solidly there by crossbar clamp *B* in the toolpost. The square frame *C*, mounted on the base and held in position by countersunk screws *D* is made from $\frac{1}{2}$-in. brass stock. In the present case it happened that the center line of the Pratt & Whitney bench lathe is $\frac{3}{4}$ in. above the top of the toolrest; therefore, the frame *C* could be drilled centrally for the centerpunch *E*, which is made from $\frac{3}{16}$ in. drill rod. The frame *C* should be tapered towards the ends

at *F* to facilitate close work. The punch *E* is made with a 60-deg. point at one end, and a small center at the other end, the point being heat-treated.

Use of the device is simplicity itself. It is mounted parallel to the lathe ways if index marks are to be struck into a faced surface of the work. The best "striker" is an automatic centerpunch, which gives uniform punch marks; hence, the centered back of the punch *E*.

If index marks are to be struck into a turned surface, the device is simply turned through 90 deg. on



This center punch, located on the center line of the lathe spindle, can be used to strike index marks or to indicate concentric circles on the work

the toolrest and the punch inserted in the opposite direction. Placed this way, it is possible not only to strike in punch marks wherever desired, but to scribe parallel lines accurately spaced. To do this, the punch is simply held with moderate pressure against the cylindrical surface, and the lathe spindle revolved. The longitudinal micrometer on the lathe is then used to determine the spacing. Placed the other way, concentric circles can be scribed on faced surfaces, again spaced as accurately as the transverse micrometer on the lathe allows.

Should greater accuracy of location be desired for the punch *E* the correct procedure would be to bore the hole with the frame in place, using a boring bar and advancing the carriage, then reaming the holes to fit the punch. But no need of such a refinement has been apparent in the use to which this particular tool has been placed.

It is planned to increase the utility of this tool by using a spindle, slotted at one end, and carrying an inserted center drill in the other. Then accurately positioned holes can be made simply by using a light electric drill with a guided screwdriver bit in its chuck.

Tool Depth for Threads Easily Calculated

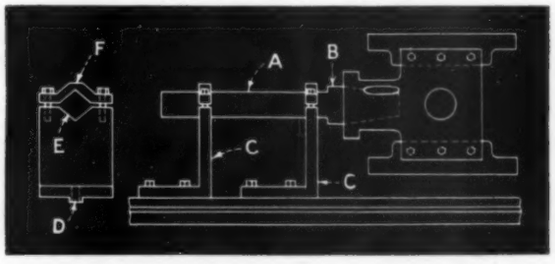
BY GEORGE J. SCHMIDT

When cutting threads on a lathe, the compound rest is usually set at 30 deg., and the tool fed in at that angle. The usual assortment of tables in the machine shop give the pitch and depth of the thread but not the depth of tool travel at 30 deg. Machinists haven't time to look for trigonometric tables to make the necessary calculations for tool travel at this or other angles. The procedure I follow is to add one zero in front of the pitch and add to this dimension the depth of the thread, which gives me the tool travel. For example, with a nine pitch thread, the pitch is 0.111 in., to which I add the zero and obtain 0.01111. Then this figure plus the depth of the thread, or 0.0111 + 0.0721, gives the tool travel—in this case, 0.0833 in.

Fixtures for Machining Crosshead Shoes

BY ARTHUR HAVENS

A simple and accurate method for machining locomotive crosshead shoes is to use a fixture, such as the one illustrated in the drawing, whereby the crosshead can be swiveled 180 deg. about a given centerline. Scrap piston rods *A* are flame cut into short



This fixture for holding locomotive crosshead shoes, permits swiveling the crosshead 180 deg. for machining the shoes for exact distances between crosshead guides

pieces saving the crosshead fit *B*. If these are not available, short pieces of round stock may be machined with long tapers so that each one will fit different crossheads. However, a sufficient number of scrap are usually available around the enginehouse or backshop to make unnecessary the use of special rods for part *A*.

Soft steel is forged into angles, or pieces may be flame cut and welded to form the angle part *C*.

These pieces should be about 1¾ in. thick when finished. A ⅜-in. tongue *D* is planed on the bottom to fit the grooves in the planer bed. The angles are held securely to the planer with two ⅞-in. square head bolts.

The Vee *E* in the top, planed after the angles are bolted to the planer, is made to fit and hold the piston rod regardless of its diameter. The top or cap *F* is made from 1¾ in. square stock, since considerable pressure will be exerted upon it while holding the rod in place for planing the shoes. The caps are fastened down by two ⅞-in. studs. The distance from the base to the Vee will vary with the size of the crosshead to be planed, since the fixture must hold the bottom shoe clear of the planer bed. The finished size is laid out on the shoes, the crosshead is squared with the planer bed, and the top shoe planed to size. After the hold-down studs are loosened, the crosshead is turned 180 deg., squared up again, and the other shoe planed. In this manner, the exact distance between the guides, allowing for clearance, is planed on each shoe.

Sine Bar That Can be Used for Wide Angles

BY WILLIAM S. ROWELL

An adjustable sine bar designed for holding work at wide angles was described by F. E. Clarke (*AM.* Vol. 85, page 339). It is well that the design includes the protractor for the following reasons:

If the protractor as shown (about 2.3 in. radius) were accurately graduated and has a vernier reading to 5 min., it may be thought of as giving accurate settings to within 5 min. Presume however a plus or minus error of 0.0005 in. in the graduations, and an equal error in setting; then it would be possible that an attempted setting of 89 deg. 55 min.—using the protractor—would be in error plus or minus 0.001 in. on a 2.3 in. radius, or an error of 0.0004348 in. on a 1 in. radius, which equals a plus or minus error of nearly 1 min. 30 sec.

Even if one is supplied with Johansson or similarly accurate gage blocks, he could not be expected to build up accurately sines of angles as large as 89 deg., because sines in this sector of a quadrant vary only a few millionths of an inch per minute of arc at a 10 in. radius.

If the use of sine setting of the angleplate be confined to angles of 45 deg. or less—where the length of sine varies more than 0.002 in. for each second of the arc with a radius of 10 in., it can be used successfully. But it should not be considered accurate for larger angles.

The weakness of the sine method of obtaining angles have not always been appreciated by its users. They are (a) the sine varies so minutely in small changes of angle above 45 deg. that very few shops can supply gages of sufficient accuracy for setting the desired angle, and (b) if gages, accurate to 0.000002 in., were obtainable, variations of heat and clamping strains would in most cases cancel, or more than cancel, this accuracy to an unknown extent.

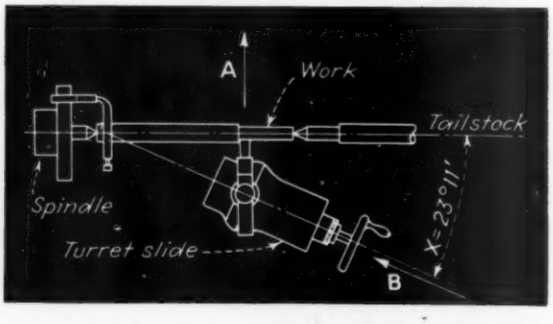
It is well to remember that a temperature change of 5 F. in such gages as the one described by Mr. Clarke would, when making a sine setting for a large angle, change the length of the gage about 0.00033 in., equally in sine length a difference of 10 sec. of arc in the angular setting of the fixture. Therefore, all attempts to obtain minutely accurate angle setting—for large angles—by the use of the sine are very likely to result in disappointment.

One way to continue the use of sine settings of Mr. Clark's device through large angles is by the use of 90- 45- and 30-deg. wedges accurately made and secured tightly on the base plate. Then a setting of 45 deg. 59 min. 30 sec. would require, in addition to the 45-deg. wedge, a gage 0.17307 in. thick. This is based on the calculation: Sine 59 min. 30 sec. = 0.017307 for a 1-in. radius, or 0.17307 for a 10-in. radius.

Millimeter Feeds Made on Standard Lathes

BY EARNEST BERGER

Recently, we found it necessary to turn work in a lathe to specifications given in millimeters. Since the cross-slide and turret-slide indexes were calibrated for 0.001 in. movement, some means had to be determined



By swiveling the turret slide on the lathe to 23 deg. 11 min., a 0.001 in. movement of the turret slide will advance the cross-slide 0.01 mm. for turning stock to millimeter dimensions

whereby final adjustment for finish cuts would move the tool a definite number of millimeters by adjustment of the cross-slide.

This was accomplished by swiveling the turret slide to an included angle of 23 deg. 11 min. with the axis of the work piece. After this was done, the tool moved in 0.01 mm. radially, in direction *A* shown in the drawing, when the turret slide moved 0.001 in. in direction *B*. After such movement of the turret slide, the turning operation was completed by using the power longitudinal feed. The calculation is based upon the formula:

$$\frac{\text{Radial movement } A}{\text{Turret-slide movement } B} = \text{Sin X}$$

Chemical Composition of SAE Steels—I

Courtesy Society of Automotive Engineers

TURNING BACK the tide of increasing variations in the chemistry of steels demanded by users in recent years, the revised standards provide for 72 carbon and alloy grades and 12 corrosion and heat-resisting alloys—a total of 84 in place of the 109 SAE standard steels included in the replaced series.

The revised series is the result of nearly a year's work by the Iron and Steel Division of the SAE Standards Committee, the last previous general revision in these specifications having been made in 1935. To carry out the present important revisions data were sought and obtained on the use of SAE steels from machine-tool builders, electrical manufacturers, railroads, and scores of other non-automotive users as well as from every part of the automotive industry itself. Final decisions were reviewed in cooperation with a technical committee of the American Iron and Steel Institute which had recently completed a survey restricted to steel producers and, in general, the conclusions reached by the two separate groups with respect to popular and desirable SAE compositions were similar.

It is the belief of the Iron and Steel Division that the needs of the automotive and general user are adequately met with this revised list—and that this first and substantial step in the direction of simplification will inspire a determination on the part of both steel makers and steel users to seek a further diminution in varieties, to the end that increased volume in fewer production streams will facilitate more rapid deliveries and insure lower steel costs.

These revised SAE steel specifications have been listed under two headings: "Primary" and "Secondary." "Primary steels" are those used in substantial quantities; "secondary steels" are those considered essential by certain users, but not used extensively. This listing will indicate to users the limited-source materials and encourage them, where practicable, to adopt a primary steel for their purpose.

[1] Silicon range of all SAE basic open hearth alloy steels shall be 0.15–0.30. For electric and acid open hearth alloy steels, silicon content shall be 0.15 minimum.

The composition limits of SAE steels apply to the steels as delivered to the purchaser. The Iron and Steel Division has not approved any chemical tolerances beyond these limits.

CARBON STEELS

SAE No.		Carbon Range	Manganese Range	Phosphorus Max.	Sulfur Max.
Primary	Secondary				
1010	.....	0.05–0.15	0.30–0.60	0.045	0.055
1015	.....	0.10–0.20	0.30–0.60	0.045	0.055
X1015	.....	0.10–0.20	0.70–1.00	0.045	0.055
1020	.....	0.15–0.25	0.30–0.60	0.045	0.055
1020	.....	0.15–0.25	0.70–1.00	0.045	0.055
1025	.....	0.20–0.30	0.30–0.60	0.045	0.055
....	X1025	0.20–0.30	0.70–1.00	0.045	0.055
1030	.....	0.25–0.35	0.60–0.90	0.045	0.055
1035	.....	0.30–0.40	0.60–0.90	0.045	0.055
1040	.....	0.35–0.45	0.60–0.90	0.045	0.055
1045	.....	0.40–0.50	0.60–0.90	0.045	0.055
1050	.....	0.45–0.55	0.60–0.90	0.045	0.055
1055	.....	0.50–0.60	0.60–0.90	0.040	0.055
1060	.....	0.55–0.70	0.60–0.90	0.040	0.055
....	1065	0.60–0.75	0.60–0.90	0.400	0.055
....	X1065	0.60–0.75	0.90–1.20	0.040	0.055
1070	.....	0.65–0.80	0.60–0.90	0.040	0.055
1075	.....	0.70–0.85	0.60–0.90	0.040	0.055
1080	.....	0.75–0.90	0.60–0.90	0.040	0.055
1085	.....	0.80–0.95	0.60–0.90	0.040	0.055
1090	.....	0.85–1.00	0.60–0.90	0.040	0.055
1095	.....	0.90–1.05	0.25–0.50	0.040	0.055

FREE CUTTING STEELS

SAE No.		Carbon Range	Manganese Range	Phosphorus Range	Sulfur Range
Primary	Secondary				
1112	.....	0.08–0.16	0.60–0.90	0.09–0.13	0.10–0.20
X1112	.....	0.08–0.16	0.60–0.90	0.09–0.13	0.20–0.30
1115	.....	0.10–0.20	0.70–1.00	0.045 max.	0.10–0.20
X1314	.....	0.10–0.20	1.00–1.30	0.045 max.	0.10–0.20
X1315	.....	0.10–0.20	1.30–1.60	0.045 max.	0.10–0.20
X1330	.....	0.25–0.35	1.35–1.65	0.045 max.	0.10–0.20
X1335	.....	0.30–0.40	1.35–1.65	0.045 max.	0.10–0.20
X1340	.....	0.35–0.45	1.35–1.65	0.045 max.	0.10–0.20

MANGANESE STEELS[1]

SAE No.		Carbon Range	Manganese Range	Phosphorus, Max.	Sulfur, Max.
Primary	Secondary				
1330	.....	0.25–0.35	1.60–1.90	0.040	0.050
1335	.....	0.30–0.40	1.60–1.90	0.040	0.050
1340	.....	0.35–0.45	1.60–1.90	0.040	0.050
....	1350	0.45–0.55	1.60–1.90	0.040	0.050

CHROMIUM STEELS[1]

SAE No.		Carbon Range	Manganese Range	Phosphorus, Max.	Sulfur, Max.	Chromium Range
Primary	Secondary					
5120	.....	0.15–0.25	0.60–0.90	0.040	0.050	0.60–0.90
5140	.....	0.35–0.45	0.60–0.90	0.040	0.050	0.80–1.10
5150	.....	0.45–0.55	0.60–0.90	0.040	0.050	0.80–1.10
52100	.....	0.95–1.10	0.20–0.50	0.030	0.035	1.20–1.50

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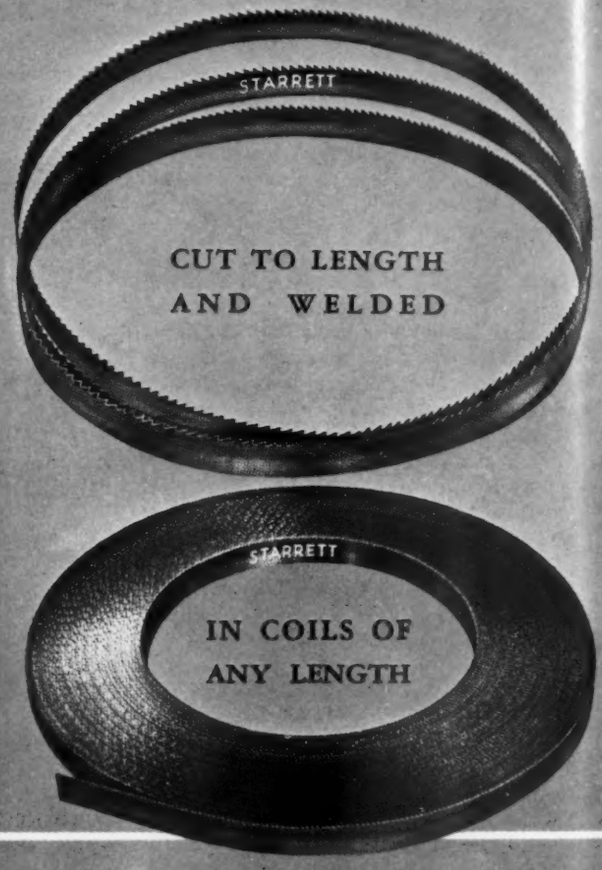

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Chemical Composition of SAE Steels—II

NICKEL STEELS[1]

Phosphorus, Max. 0.040; Sulphur, Max. 0.050

SAE No.		Carbon Range	Manganese Range	Nickel Range
Primary	Secondary			
2315	....	0.10–0.20	0.30–0.60	3.25–3.75
2330	....	0.25–0.35	0.50–0.80	3.25–3.75
2340	....	0.35–0.45	0.60–0.90	3.25–3.75
2345	....	0.40–0.50	0.60–0.90	3.25–3.75
....	2515	0.10–0.20	0.30–0.60	4.75–5.25

NICKEL CHROMIUM STEELS[1]

Phosphorus, Max. 0.40; Sulphur, Max. 0.50

SAE No.		Carbon Range	Manganese Range	Nickel Range	Chromium Range
Primary	Secondary				
....	3115	0.10–0.20	0.30–0.60	1.00–1.50	0.45–0.75
3120	....	0.15–0.25	0.50–0.80	1.00–1.50	0.45–0.75
....	3130	0.25–0.35	0.50–0.80	1.00–1.50	0.45–0.75
3135	....	0.30–0.40	0.50–0.80	1.00–1.50	0.45–0.75
3140	....	0.35–0.45	0.60–0.90	1.00–1.50	0.45–0.75
X3140	....	0.35–0.45	0.60–0.90	1.00–1.50	0.60–0.90
3145	....	0.40–0.50	0.60–0.90	1.00–1.50	0.45–0.75
3150	....	0.45–0.55	0.60–0.90	1.00–1.50	0.45–0.75
....	3215	0.10–0.20	0.30–0.60	1.50–2.00	0.90–1.25
....	3220	0.15–0.25	0.30–0.60	1.50–2.00	0.90–1.25
....	3240	0.35–0.45	0.30–0.60	1.50–2.00	0.90–1.25
....	3245	0.40–0.50	0.30–0.60	1.50–2.00	0.90–1.25
....	3250	0.45–0.55	0.30–0.60	1.50–2.00	0.90–1.25
3312	....	max. 0.17	0.30–0.60	3.25–3.75	1.25–1.75
....	3415	0.10–0.20	0.30–0.60	2.75–3.25	0.60–0.95

[1] Silicon range of all SAE basic open hearth alloy steels shall be 0.15–0.30. For electric and acid open hearth alloy steels, the silicon content shall be 0.15 minimum.

MOLYBDENUM STEELS[1]

Phosphorus, Max. 0.040; Sulphur, Max. 0.050

SAE No.	Carbon Range	Manganese Range	Chromium	Nickel Range	Molybdenum Range
Primary					
X4130	0.25–0.35	0.40–0.60	0.80–1.10	.....	0.15–0.25
4140	0.35–0.45	0.60–0.90	0.80–1.10	.....	0.15–0.25
4150	0.45–0.55	0.60–0.90	0.80–1.10	.....	0.15–0.25
4320	0.15–0.25	0.40–0.70	0.30–0.60	1.65–2.00	0.20–0.30
X4340	0.35–0.45	0.60–0.90	0.60–0.90	1.65–2.00	0.20–0.30
4615	0.10–0.20	0.40–0.70	.....	1.65–2.00	0.20–0.30
4620	0.15–0.25	0.40–0.70	.....	1.65–2.00	0.20–0.30
4640	0.35–0.45	0.50–0.80	.....	1.65–2.00	0.20–0.30
4815	0.10–0.20	0.40–0.60	.....	3.25–3.75	0.20–0.30
4820	0.15–0.25	0.40–0.60	.....	3.25–3.75	0.20–0.30

CHROMIUM VANADIUM STEELS[1]

Phosphorus, Max. 0.040; Sulphur, Maq. 0.050

SAE No.		Carbon Range	Manganese Range	Chromium Range	Vanadium	
Primary	Secondary				Min.	Desired
....	6135	0.30–0.40	0.60–0.90	0.80–1.10	0.15	0.18
6150	....	0.45–0.55	0.60–0.90	0.80–1.10	0.15	0.18

SILICON MANGANESE STEELS

Phosphorus, Max. 0.040; Sulphur, Max. 0.050

SAE No.		Carbon Range	Manganese Range	Silicon Range
Primary	Secondary			
9250	.....	0.45–0.55	0.60–0.90	1.80–2.20
9260	.....	0.55–0.65	0.60–0.90	1.80–2.20

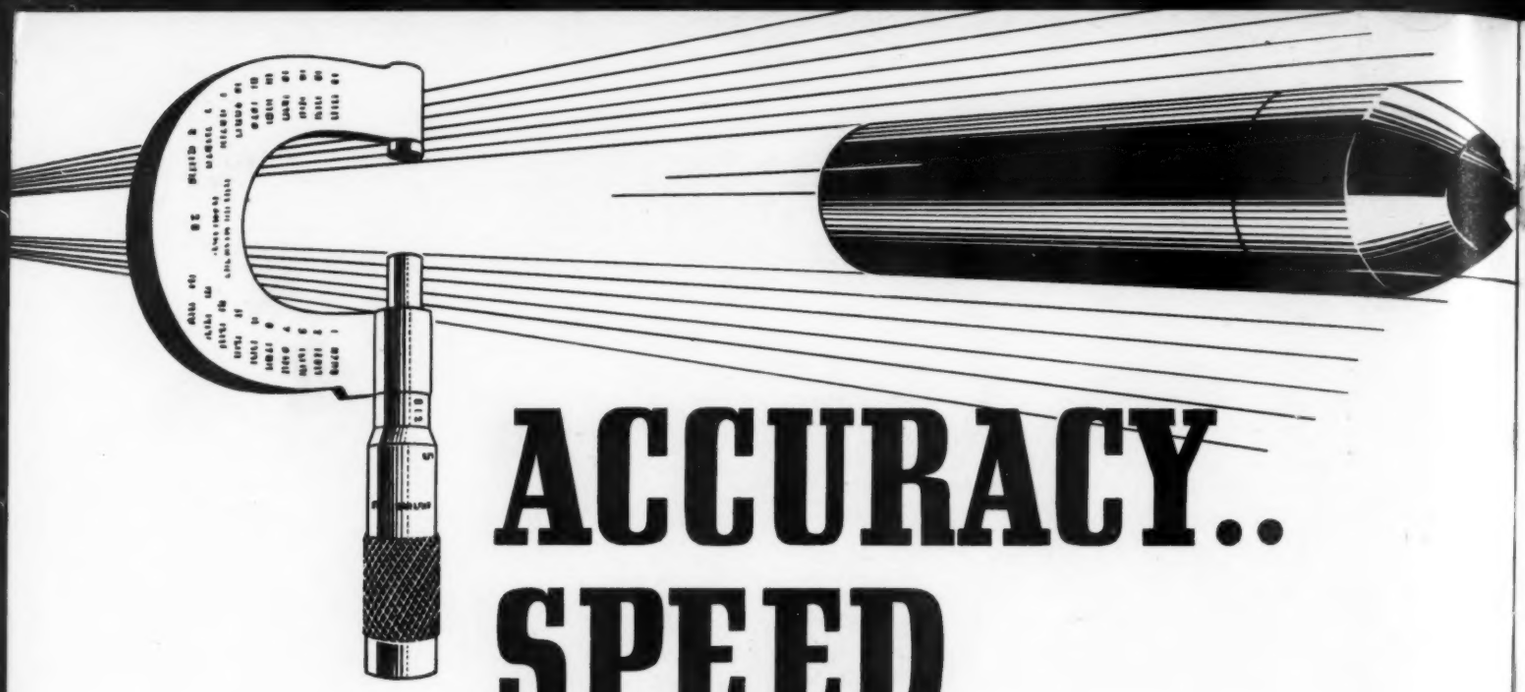
CHROMIUM NICKEL AUSTENITIC STEELS — NOT CAPABLE OF HEAT TREATMENT

SAE No.	AISI[1] Type	Carbon	Manganese, Max.	Silicon, Max.	Phosphorus	Sulfur	Chromium Range	Nickel Range	Molybdenum	Selenium Range	Titanium or Columbium
30615 (type 1)	303	0.15 Max.	2.00	0.75	0.04 Max.	0.18–0.35	17.00–20.00	7.00–10.00	0.60 Max.	....	....
30615 (type 2)	303	0.15 Max.	2.00	0.75	0.12–0.17	0.04 Max.	17.00–20.00	7.00–10.00	0.60 Max.	0.15–0.35	....
30705	321	0.08 Max.	2.50	1.50	0.03 Max.	0.03 Max.	17.00 Min.	8.00 Min.	....	....	0.40[2] Min. 0.70[2] Min.
	347										
30805	316	0.10 Max.	2.50	0.75	0.03 Max.	0.03 Max.	16.00–18.00	10.00–14.00	2.00–3.00	.....	....
30905	304	0.08 Max.	2.00	0.75	0.03 Max.	0.03 Max.	18.00–20.00	8.00–10.00	....	....	....
30915	302	0.08–0.15	2.00	0.75	0.03 Max.	0.03 Max.	17.00–20.00	7.00–10.00	....	....	....

STAINLESS CHROMIUM IRONS

SAE No.	AISI[1] Type	Carbon	Manganese, Max.	Silicon, Max.	Phosphorus, Max.	Sulfur	Chromium Range	Nickel Range	Molybdenum, Max.
51210	410	0.08–0.15	0.60	0.50	0.03	0.03 Max.	11.50–13.00	....	....
51310	414	0.08–0.15	0.60	0.50	0.03	0.03 Max.	11.50–13.50	1.25–2.00	....
51335	420	0.25–0.40	0.60	0.50	0.03	0.03 Max.	12.00–14.00	....	....
X51410	416	0.13 Max.	1.20	0.75	0.04	0.18–0.35	12.00–14.00	....	0.60
51710	430	0.12 Max.	0.60	0.50	0.03	0.03 Max.	16.00–18.00	....	....

[1] American Iron and Steel Institute. [2] Minimum if Titanium is used. [3] Minimum if Columbium is used.

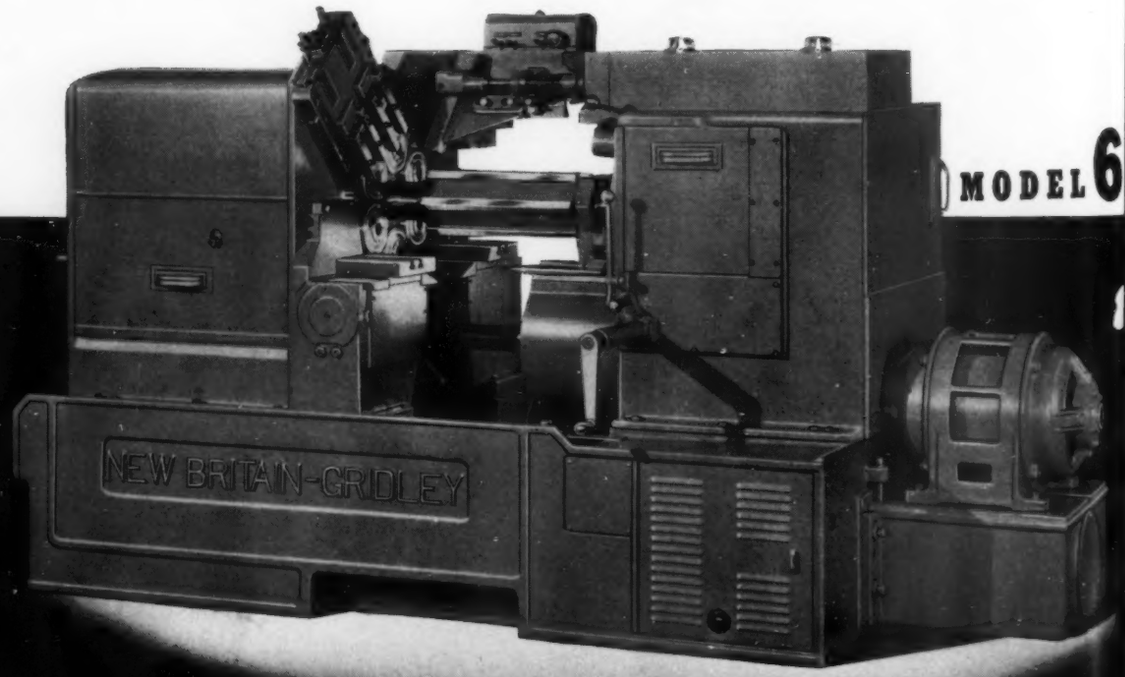


ACCURACY.. SPEED

Defense production calls for both. Against the background of these urgent times New Britain Automatics' extreme accuracy reduces rejects; their speed helps meet and beat schedules. New Britain Automatics stay on the job.

NEW BRITAIN-GRIDLEY

MACHINE DIVISION · THE NEW BRITAIN MACHINE COMPANY · NEW BRITAIN · CONNECTICUT



MODEL 6

A complete line of Screw Machines — Four and Six Spindles to 2¼" Capacity
Also a complete line of Chuckers — Four, Six and Eight Spindles to 10¼" Capacity

Bogged Down?

IF YOU READ the columnists and the news reports from Washington, you'd think that the defense production machine was bogged down in mud right up to its hub caps.

Armament isn't rolling off the line, say the critics. A finger is pointed at labor, because man-hours are lost in strikes. The army and navy are accused of not knowing what they want and of waiting unnecessarily long in ordering munitions. Individual cases are cited where Washington bureaucracy has delayed important projects at a moment when every passing twenty-four hours is precious. A warning is waggled at industry because it is not yet turning out planes and tanks and guns in prodigious numbers.

Each critic has his own pet scapegoat, but all critics unite in shaking their heads sadly over the state of affairs.

It is our forthright opinion that only part of this pessimism is justified. Things are in better shape than the crepehangers would have you believe. Sure, lots of mistakes have been made. Sure, production has not climbed as those who are alive to the gravity of the international situation would like to have had it. Sure, the full scope of the program is just unfolding before our eyes and it becomes evident that we have only made a start.

But the start has been a good one. We have not been idling since last September, when the program really began. Our accomplishments in the intervening months have been notable. What are they?

To mention only a few: Our military airplane output has tripled within the year. Ten light tanks a day are being produced. By late summer four companies will be building medium tanks. Four machine gun plants are in operation, four more will come in during June, another in July and two more in August. In explosives, three plants are in production, another will start in July, another in October and still another a month later.

One shell loading factory is now running, four more will begin work next month. One aircraft cannon plant is turning out units, a second is about to start, and two others are making good progress in tooling up. A U. S. Navy ship is being launched every ten days, and a new cargo ship every five days. Some 800 new factories have been built, and contracts have been let for over $13,000,000,000 of defense goods, an enormous undertaking in itself.

The machine tool industry, going along at a volume of about $200,000,000 annually when the defense program was undertaken, has stepped up its pace to the unprecedented level of $750,000,000 a year and is producing over 1,000 machines a day for defense factories. The volume by the end of the year may well be close to a rate of a billion dollars a year.

Anyone who says that such a record is not good, in view of the fact that our nation has not been at war and that a strong minority has not accepted the emergency's being as great as war itself, is deliberately closing his eyes to a real achievement.

We have come a long way down the rearmament road since France fell. We have a long way yet to go before we can attain national security and give Britain the full aid which she needs. But we are not bogged down. It is a hindrance rather than a help to the defense program to preach such defeatist doctrine.

Burnham Finney

GAGING BUSINESS

Need for machine tools for anti-aircraft production is so urgent that it is momentarily taking precedence over the bomber program. Award huge aircraft contracts; start wide expansion in munitions

Many munitions plants which have been tooling up for manufacture of defense products will get into real production before the end of this summer. A substantial portion of the tooling of defense factories is already completed. Yet the program now coming along, which will supplement previous programs, will require intensification of operations of metal-working plants beyond any volume heretofore contemplated.

Machine Tools—Machine tools are so urgently needed for anti-aircraft gun plants that this program momentarily is taking precedence over requirements for the bombing plane program. Machine-tool people are loud in their praise of the dispatch with which OPM is handling the allocation of orders in connection with bomber production facilities. As soon as military authorities definitely decide what they want, OPM is giving letters of intent to machine-tool builders, who are able to make plans immediately for scheduling the heavy volume of work involved. In contrast to the speed in getting bomber manufacturing needs taken care of, orders under the Lend-Lease program are trickling through at a slow pace, largely due to the fact that all Lend-Lease orders must travel such a tortuous route in Washington before being placed with industry. It is believed that May production of machine tools was somewhat above the April total of $60,000,000. Bookings are running slightly above output, but in a few cases improvement in deliveries is reported. A number of companies say that they have exhausted all the available skilled labor supply and are entirely dependent upon training new men who are absorbed as rapidly as possible after a short instruction period. Subcontracting has been further intensified. One builder, for instance, will farm out 70 per cent of its dollar volume received for the bomber program.

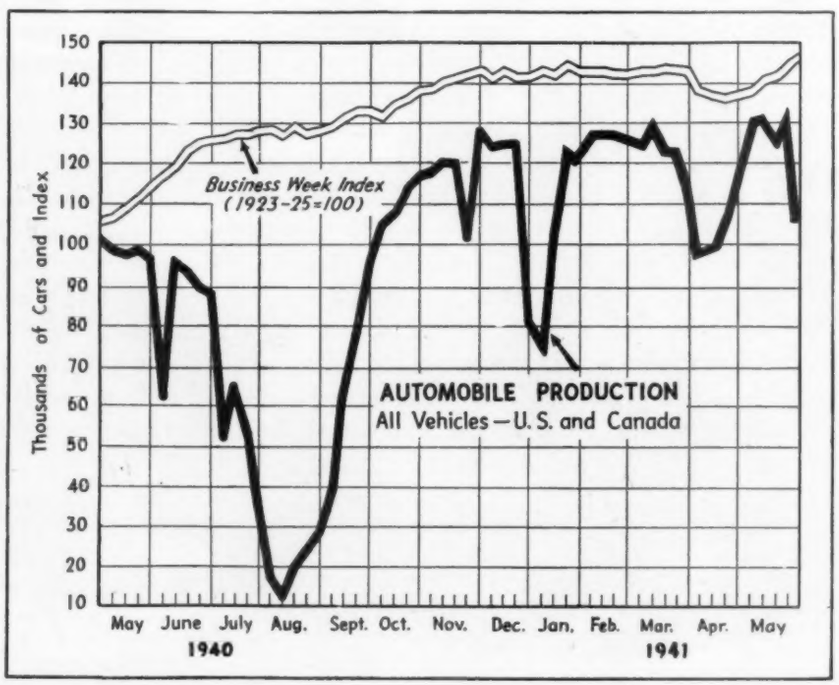
Railroad Equipment—An avalanche of freight car orders descended on car builders in May, a total of 23,000 units being booked. That was the largest month's business since September, 1939. Already the volume of orders has surpassed that in the entire year of 1940 by some 2,000 units. Pending inquiries are heavy. Locomotive business has been very active. Car builders now have enough orders to work at full capacity the remainder of the year, but are having trouble getting steel. Indications are that Washington will give steel a high priority rating because of the serious need for freight cars.

Munitions—The award of three great Army munitions plants the past week is the beginning of a huge new program for building new capacity as fast as possible. This program is of such vast scope and will call for such immense amounts of materials, labor, equipment and supplies that its imposition on top of what already is in progress will produce a relatively greater dislocation of business than has the program previously undertaken. Production plans for which contracts may be let are still unavoidably slow in coming through. A case in point is heavy tanks for the Army. Designs are still being revised. American Car & Foundry is turning out 10 light tanks a day. Two small arms munition plants are in operation, one more will come in during June, another in July and a third in August. One aircraft cannon factory is in production, a second is on the verge and two others are tooling up. One new shell loading plant is operating, four more will be ready in July, and two others are under construction.

Aircraft—Huge new contracts have been placed by the government with West Coast airplane companies. Consolidated led the list with orders totaling $390,276,200 for bombers and parts. Boeing is to build new facilities for bomber construction costing $17,500,000 at Wichita, Kan. The new bomber program, principally designed for British aid, is to be given right of way over almost everything else and some of the new plants intended for other plane production are likely to be used for heavy bombers. Key automotive plant in the bomber program is the new Ford factory at Ypsilanti, Mich. Allison Division of General motors has added 175 hp. to its liquid-cooled engine and cut down the weight to less than one pound per horse-power. The new model will soon be in production. Allison production is about 400 a month and will be increased to 1,000 by December. Vultee and Northrup have ordered tools and jigs jointly so that all parts will be interchangeable in the new Vengeance dive bomber to be made for the British.

Steel—OPM is taking steps to curtail sheet and strip steel production for automobiles, refrigerators and other non-defense uses to release rolling mill capacity to turn out plates urgently needed for shipbuilding, railroad cars and other defense requirements. Some sheet mills already are in the process of installing equipment for conversion of mills to plate manufacture. Though steel is not under as rigid a priorities set-up as some other materials, rationing is definitely at hand and will be used more extensively in the weeks ahead.

Shipbuilding—A new ship for the U. S. Navy is reported being launched every ten days, a new cargo vessel every five days. Manitowoc Shipbuilding Corp., Manitowoc, Wis., expects shortly to lay the keel of the first submarine ever to be built on the Great Lakes. As new ways are built at shipyards, banks of steel are being accumulated to make sure that the ship program is not delayed by lack of raw materials.



Step-up in Heavy Bomber Program May Displace Some Existing Aircraft Projects

WASHINGTON — The "500-a-month" heavy bomber program is not simply to be superimposed on the existing aircraft schedules as was done in the Detroit bomber program. Instead it is actually to displace some existing projects. Thus, where it had originally appeared that production under the new plans would come early in 1943, it now looks as if there may be substantial expansion of heavy equipment output as early as a year from now.

Two nearly completed plants, intended for production of light bombers and military transports, are to be diverted to production of four-engine bombers. Moreover priority ratings two steps higher than those attached to the rest of the aircraft program are being given to the bomber orders. This means that tools and equipment intended for other plane plants can be grabbed for the new bomber program.

Since last summer there has been a steadily increasing emphasis on heavy bombers. The aircraft schedules set up at that time called for a capacity to be achieved by July 1942 of 65-85 four-engine ships a month, about two-thirds Boeings and the rest Consolidateds. Production under these schedules has now reached some 30 a month.

Last fall plans were made to step up production of Consolidated bombers by 100 a month, effective in mid-1942. Government owned assembly plants at Tulsa and Forth Worth were to be operated by Consolidated and Douglas, and parts and subassemblies were to be furnished by Ford from a new plant to be built at Ypsilanti, Mich. These three plants are now under construction, and this month contracts were placed for bombers to be built in the plants. Small scale production is expected to start late this year.

Current expansion would provide capacity for some 300 additional heavy bombers a month—largely Boeings. Ford is to manufacture an unspecified number of Consolidateds in his Ypsilanti plant, which he built oversize in anticipation of such a plan. The Boeings are to be assembled by the Boeing firm itself, Douglas, and Lockheed. Boeing will build a new government-financed plant of 1,320,600 sq.ft. at Wichita, where its Stearman division is already manufacturing trainers and bomber parts. This is the only new plant scheduled.

Douglas will use its nearly completed Long Beach plant for its share of the assembly job. This plant was intended for the manufacture of Douglas' A-20-A light attack bomber and military transports. Lockheed will use its new Vega plant at Burbank, Cal., which was to have been used for manufacture of the Vega-Ventura, a medium bomber for the British.

Operations of the three firms building Boeings will be coordinated through a newly formed committee representing the companies, the Army, and OPM. Purchase of parts and subassemblies for all the Boeings will be coordinated through this committee. Operations of the airplane companies will largely be restricted to assembly. Source of parts has not yet been revealed. But it is known that original plans for Long Beach operations contemplated extensive use of auto body firms, particularly Briggs, and some of these arrangements will likely be switched over to the bomber work.

How much production is involved in the plants so far announced is not known, though it is understood to be in the neighborhood of 150-200 a month. This would leave sources still to be found for 100 to 150 bombers a month. It is thought likely some auto firms other than Ford may be asked to assemble planes. Also still to be worked out is the contemplated expansion of the medium bomber program.

LATE DEFENSE CONTRACTS

WASHINGTON—Consolidated Aircraft Corp., San Diego, Calif., topped the recent government awards when it received orders for bombers and parts amounting to $390,276,200. Other aircraft awards were: Boeing Aircraft Co., Seattle, Wash., $95,242,696; Douglas Aircraft Co., Inc., Santa Monica, Calif., $158,850,000; Lockheed Aircraft Corp., Burbank, Calif., $47,769,196; and Curtiss-Wright Corp., Robertson, Mo., $31,904,381.

Shortage of Shipping For Imports Worries U. S.

WASHINGTON—Because OPM, Army and Navy are worried about shortage of shipping to move vast imports of rubber, tin, wool and other materials essential to defense and to handle domestic materials and supplies in our own waters, the Maritime Commission has stepped up its regular schedule of 50 "C" ships a year to 85 a year. The new contracts call for 123, but the difference of 38 are contracted under Lease-Lend funds and will be turned over to the British, whose shipping troubles are on the margin of disaster.

At the same time, the Commission signed contracts for eight more shipways and facilities costing $6,000,000, to be used in building part of the 123 vessels. This brings to 111 the total of emergency ways under contract and construction; 44 non-naval ways are in operation.

The merchant ship program now under construction or contracted now totals over 750. This includes 312 "emergency" ships for aid to Britain, plus 60 for the British under Todd contracts, plus 85 cargo vessels under private contract, plus 72 oil tankers being built for the Maritime Commission.

Other highlights on the maritime horizon: On its way to passage is a bill authorizing the Maritime Commission to issue warrants to owners of vessels who agree to operate them on certain routes with priority cargoes. . . . Because U. S. foreign service ships are no longer competing against foreign shipping, due to world conditions, the Maritime Commission soon will discontinue operating subsidies which in 1936 supplanted the old ocean mail contracts. . . . Last one of the 971 laid-up world war surplus ships has been sold.

Wide World

Highway to Seaway—*The "Aqua-Cheetah," invented by Roger W. Hofheins of Buffalo, N. Y., is powered by a regular auto motor, is capable of doing 60 miles an hour on land and can also be used in the water. The vehicle, leaving the Niagara River, was tested as an Army Scout Car*

American Tanks Superior, Says Assistant Ordnance Chief at S.A.E. Summer Meeting

WHITE SULPHUR SPRINGS, W. Va.—American tanks are superior in speed, fire power and other important characteristics to those of other countries, Brig. Gen. G. M. Barnes, assistant chief of ordnance, told members of the Society of Automotive Engineers gathered for their annual summer meeting here June 1-6. Captain J. E. Engler, Quartermaster Corps, presented a report on the program of procurement and accelerated testing which is putting many thousands of motor trucks, ranging from one-half ton to six-ton sizes, in the hands of the armed forces. In all 25 papers were presented in a 14-session program. Additional technical fare covered at the meeting ranged from trucks to aircraft and from fuels and lubricants to automotive power plants.

Brig. Gen. Barnes indicated that the American tank surpassed those of other countries in the important characteristics of mobility and mechanical reliability. So far as is known no other country possesses vehicles capable of traveling great distances at speed possible with the American model. He added that the Ordnance Department had outdistanced the world in the development of tank tracks, declaring that "we no longer talk of track life in hundreds of miles, but in thousands of miles. Power consumption has been reduced by approximately nine horsepower per ton of weight of vehicle at 20 miles an hour. This figure becomes extremely important when one talks in terms of 28 to 60-tons." He reported that improvements in the accuracy of fire of tank weapons in excess of 1,000 per cent has been accomplished during the past year.

Complete Design for Heavy Tank

Brig. Gen. G. M. Barnes told S.A.E. that the design of a new heavy tank had been completed and the first vehicle will be ready for test early in July. The engine used had approximately 1,000 hp. and required the development of special types of transmission.

In a paper, "American Experiences with the Buchi Turbo-Charging System," written by J. P. Stewart, Elliott Co.; Ralph Boyer, the Cooper Bessemer Corp., and John W. Anderson, American Locomotive Co., it was indicated that supercharged engines must be used increasingly in the future. They wrote that it is not inconceivable that the time will come when practically all four-cycle engines will not only be supercharged in some form, but will be designed specifically for supercharging. The most important reason for supercharging is, of course, to obtain more output with less weight and space. It was concluded that the ultimate possibilities of supercharging are still very largely unexplored.

H. L. Knudsen, Cummins Engine Co., in discussing "Problems and Possibilities of Mechanical Supercharging of Diesel Engines," indicated that the Cummins Engine Co., elected to use the Roots type blower in engines for supercharging and has been able to increase its output as much as 60 per cent in that manner.

Raymond W. Young, Wright Aeronautical Corp., discussed the "Design Features and Performance Characteristics of the Mercedes-Benz DB-601A Aircraft Engine," used by the Germans. He concluded that the DB-601A reflects in design a ruggedness and reliability which has always characterized Mercedes-Benz products. He indicated that careful attention had been paid to seemingly unimportant details which may mean the difference between success and failure in a given design. From the manufacturing point of view, the design represents, with possibly several minor exceptions, good mass production practice for military aircraft power plants with the use of modern machine tools for specific operations. The design of the engine allows for an unfaltering take-off with a stone cold engine. This is particularly required of fighter and intercepter planes. It has been reported from abroad that take-off with a cold engine in the German fighting plane is accomplished on a few seconds notice. A supplementary tank filled with a mixture of ether and gasoline are used for priming. A secondary tank containing fuels mixed with a small percentage of oils is used during take-off and climb. The take-off is made almost immediately after starting the engine, and the switch to straight gasoline is not made until the normal operating temperatures of coolant and oil have been attained. The performance of the DB-601A with respect to sea level and altitude output, fuel consumption, and weight seems to be quite on a par with other contemporary power plants of the same general type.

Philip D. Jackson, engineer, castings division, Aluminum Co. of America, indicated in his paper, "Aluminum Alloy Applications for Major Diesel Engine Parts," that aluminum contributes to the improved performance of modern engines. He said that sufficient stiffness is obtainable with aluminum to give reliable operating experience, and that weight reduction of considerable magnitude results from the use of aluminum castings. Stress distribution of a high order is obtainable in aluminum without presenting the foundry with problems requiring unusual practices or supervision and, he maintained, water jacketed castings are practical.

NOMINATE A. S. M. OFFICERS

CLEVELAND—Bradley Stoughton, Dean of Engineering, Lehigh University, Bethlehem, Pa. has been nominated for president, the American Society for Metals. H. J. French, in charge of alloy steel and iron development, International Nickel Co., New York, N. Y. has been nominated for vice-president. The election will be held in October at the annual meeting of the Society.

Copper and Steel Put Under Priority Control

WASHINGTON — Priority control reached into much broader fields of industry last month when steel and copper came into the system. Copper was subjected to industry wide control, while a new, less rigid form of control was applied to steel. At the same time some red tape was spared metal users by a series of interpretations of the recently imposed metal inventory control.

Government control over the distribution of steel tightened with the announcement by the Priorities Division of OPM of a so-called General Steel Preference Delivery Order. This is a less rigid form of control than the industry-wide allocation now used for aluminum, nickel steel, and a number of other commodities. In essence, it formalizes the semi-voluntary preference which has been granted by the steel industry in the past to defense orders and at the same time provides a court of appeals for steel customers.

The order directs producers of "pig iron, ferro-alloys, steel ingots and castings, and all carbon and alloy steel products" to give preference to orders entering into defense. Any customer whose order is rejected or who is unable to obtain prompt delivery and who feels that this is unjust may appeal to OPM on a form, PD-32, obtainable at Federal Reserve banks. OPM will thereupon order the steel producer to tell why the order was rejected or delayed and may order the producer to accept or advance the order.

This novel form of control was adopted, it appears, primarily, because it could be put into effect quickly to meet the increasingly tight steel situation. As details are worked out it seems likely that a general allocation system similar to that in use for other rationed commodities will be instituted.

The control established over copper resembles that used for zinc. Producers are required to set aside a fifth of their monthly output for distribution by Priorities Division to meet emergency needs. For the rest, they are required to fill first orders having a priority rating—and permitted to assign a rating of A-10 to unrated defense orders.

Labor Situation Unchanged In Unlimited Emergency

NEW YORK—Anybody looking for important changes in labor relations under President Roosevelt's "state of unlimited emergency" found little in the last fortnight which suggested that things would be any different than before. As a matter of fact, last week produced the most ominous development yet seen as a left-wing section of C.I.O.'s International Woodworkers of America openly defied National Defense Mediation Board recommendations to call off the Puget Sound timber strike while the Board investigated the dispute. It was the first time since NDMB's creation, that a union concerned in a case before the Board, had denounced it as an anti-labor agency whose operations should be ignored.

In addition to the trouble in timber, the machinists' strike (A.F.L.) which tied up 11 San Francisco Bay Area shipbuilding yards continues under the "state of unlimited emergency". This, plus a rash of other strikes, had the effect of mocking F.D.R.'s words.

Perhaps the most dramatic of all was the closing of the Inglewood, Calif. home plant of North American Aviation. There, in response to a C.I.O. threat to strike unless a wage increase was forthcoming, the company closed the plant, explaining that it would keep operations down until the National Defense Mediation Board made its recommendations. This action was not unexpected for hardly two weeks before NDMB had, at the 11th hour of a strike deadline, averted a strike only to find the union still adamant in the subsequent period.

Scan Selected Service Act

Those who sought to determine just what the government's power is in relation to work stoppages scanned Section 9 of the Selective Service Act of 1940. All this does is to authorize the President to take immediate possession of any plant or manufacturing industry which refuses to make goods ordered by the War and Navy Departments. However, a similar but narrower statute during World War I was construed to permit the seizure of two enterprises because the employers refused to carry out recommendations of the War Labor Board. President Wilson thereupon commandeered the plant and the strikers returned to their jobs.

There was no lack of discussion in Washington this week over ways and means to implement no-strike appeals. Although there was no real basis for supposing that drastic action was imminent, many observers were interpreting the newly introduced Property Requisitioning Bill as a measure which would find Congressional support because of its labor regulating possibilities.

At the Fourth Annual Spring Outing held by the Hartford, Conn. Chapter of the American Society of Tool Engineers, A. H. d'Arcambal (kneeling) 1940-41 president of the Society, took part in the spike driving contest. Members of the chapter looking on are: F. W. Curtis, national president, A.S.T.E., and guest of honor; Irwin S. Holland, past chairman of the Hartford chapter; Henry I. Moore, chairman; Henry A. Rockwell, toastmaster; and Kenneth F. Thomas, chairman, public relations committee. The meeting, which was the Hartford Chapter's largest since its inauguration, was attended by 382 engineers and executives

Expand Steel by 10,000,000 Tons; Financing Will Be Done Largely by Government Funds

WASHINGTON—The steel industry has been asked to expand its producing facilities 10,000,000 tons to meet the country's demands during the next few years. The request was made by the OPM and OPACS and the financing will be done largely by means of government funds. Much of the responsibilities for this action rests with Leon Henderson, director of OPACS, who is charged with the job of satisfying civilian needs for materials which are heavily used in defense production.

Though Benjamin F. Fairless, president of U. S. Steel Corp., and Eugene G. Grace, head of Bethlehem Steel Corp., attended the meeting at which the decision was reached to expand, it is known that the industry will do so against its better judgment. Many steel executives still are convinced that the best thing to do is to ration non-defense users during the critical defense period rather than build new capacity and take care of all consumers, thereby creating over-capacity after the emergency has ended. Irving Olds, U. S. Steel chairman, expressed that point of view publicly within the last fortnight.

New Dealers and some defense authorities have contended right along that the national income will rise so steeply in 1941 and 1942 that more steel capacity will be essential if all civilian as well as war needs are to be met. Gano Dunn, OPM consultant, made a survey early this year which predicted that a surplus of 10,000,000 tons of steel would be available in 1941 and 2,000,000 tons in 1942. He figured on a capacity for the industry of 91,125,000 tons at the end of this year (including steel castings as well as steel ingots). In a second survey recently completed Mr. Dunn has greatly revised upward his estimate of steel demands, indicating a deficit of 1,400,000 tons this year and of 10,000,000 tons next year.

NO SUMMER VACATIONS

NEW YORK—The management and employees of Curtiss-Wright Corp., America's largest producer of airplanes, engines and propellers, have notified government officials of their decision to forego summer vacations this year. The decision involves about 38,000 workers in 14 plants. The company expects to increase its employment from approximately 38,000 to over 70,000 workers this year.

Canada Has Spent $300,000,000 for New Plant Capacity; Over $425,000,000 Committed

MONTREAL—Over the past year Canada has been authorizing expenditures of some $30,000,000 monthly for new plants and equipment to provide war material. The amount being spent on new plants and equipment now exceeds $425,000,000 and approximates the total invested in industry in Montreal or Toronto. It exceeds by about 25 per cent the total amount pre-war value of the entire Canadian metal production, including precious metals. The whole program involves an expenditure 1.6 times as great as the total ordinary expenditure of all the nine provinces of Canada in 1938. The government's investments in new chemical and explosive plants, a program now 75 per cent complete, is almost double the investment in Canadian motor car manufacturing plants prior to the war. The Canadian aircraft industry is today being extended to more than eight times its pre-war proportion.

Of the total plant commitments to date some $300,000,000 has already been expended. The commitments are approximately as follows:

Commodities	*Amount in Millions of Dollars*
Shells	$46
Guns and mountings	121
Tanks, carriers, etc	10.5
Aircraft	23
Automotive equipment	8
Bombs	2.2
Chemicals and explosives	112
Machine tools and miscellaneous	8
Materials, not end products	70
Railway equipment	24.3
Total Commitments	$425

Canada's national income in April was $434,700,000, compared with $375,300,000 in April, 1940, and $413,300,000 in March this year. The April figure was 15.8 per cent above the figure for the same month a year before, and 5.2 per cent above the March, 1941, estimate. Because of a moderate increase in the general price level, increases in real income were somewhat less proportionately than in the money income. Real income was estimated at $448,600,000 in April, compared with $402,300,000 in the same month, in 1940. This indicated a gain of $46,300,000 or 11.5 per cent.

The new government regulation requiring private industrial or business plant expansions to be approved and licensed by the government is expected to ease the supply-demand situation in steel. The action has also deferred possible price increases; there has been no upward revision in steel prices since the war started. The demand for steel is expected to reach a peak, in relation to existing capacities, by next September. Some sources predict that there will be an upward adjustment in steel prices to meet mounting costs at that time.

Canada is revising its labor regulations through amendment of the Industrial Dispute Investigation act. This act which requires that all labor disputes in industries essential to defense be automatically referred to a concilliation board made up of three members, of which one represents the workers, another the employers, and a third member (the chairman) to be agreed upon by the other two. The new amendment prohibits anyone who has a direct or indirect financial interest in the dispute to become a member of the conciliation board. The aim is to exclude professional labor organizers, and corporation lawyers. Under the old regulation there was only one impartial member on the board. The new plan is for three impartial members to be appointed.

Since the start of the war the cost of living in Canada has increased only 7.7 per cent. Rents have been kept down through government pegging of rents in industrial districts. Price increases have been restricted largely to advances due to higher ocean shipping costs, the exchange differential between the U. S. and Canada on American products. However, further increases in shipping costs and higher prices on U. S. goods will tend increase living costs in Canada.

The Canadian government has awarded recently the following contracts.

Shipbuilding: George T. Davie and Sons, Lauzon-Levis, Quebec, $648,000; Morton Engineering & Drydock Co., Ltd., Quebec, $877,509; Marine Industries, Ltd., Sorel, Quebec, $2,592,000; Kingston Shipbuilding Co., Ltd., Kingston, Ont. $648,000; and Collingwood Shipyards, Ltd., Collingwood, Ont., $1,296,000. Aircraft: Canadian Pratt & Whitney Aircraft Co., Ltd., Longueuil, Quebec. $303,943; Coleman Lamp & Stove Co., Ltd., Toronto, $204,338; DeHavilland Aircraft of Canada, Ltd., Toronto, $391,071; and Fleet Aircraft, Ltd., Ft. Erie, Ont., $147,216.

START POST WAR PLANNING

WASHINGTON—Dr. R. E. Doherty will direct the efforts of the Production Planning Board, Office of Production Management, largely toward post-war problems. Doherty, who has an industrial background, is convinced that private industry must be allowed largely to solve the terrific business readjustments which will inevitably follow the war.

More Precise Planning Needed in Defense Program

WASHINGTON—President Roosevelt's full emergency speech marked the point of maximum defense activity under the country's peace time economy. His belligerent challenge to Hitler on the Atlantic was in part an attempt to induce war energy in a people not at war. What would follow no one knew. Following the appointment of Ickes as oil king, more king pins might be appointed over fields of vital production. Still more responsibility might be shifted to Hopkins under the Lend-Lease law, leaving OPM to handle technical matters. Drastic controls might come down on materials and production and civilian consumption. Much depended on what the President was waiting for: possibly for the Nazis to shoot at our interference on the Atlantic; for signs of whether Britain can stick it out.

Disconcerting developments in the last few days made it appear that the President had cried out partly in frustration. The lack of long-range war planning began to show in shortages of oil transportation, in steel, in copper, aluminum, and other strategic metals. Labor was still striking and Mr. Roosevelt was not ready to reverse his policy and ask for power to settle disputes.

No one in authority appeared yet to appreciate the full implication of an all-out effort—that the only limit on armament production is the physical capacity to produce. Defense officials were still trying to estimate needs for material, for plant, for men, in terms of some definite limited program. When this limited view was reinforced by conservative fears of the future kick-back from undue plant expansion now, the result was that expansions of the armament schedules—a foreseeable factor—caught the planners unprepared.

The same psychology led the vital priorities and price divisions to adopt a policy of minimum possible regulation of business. Consequently, no situation has been dealt with until it became an emergency. Priority allocation has been applied to materials only when they were already terribly scarce and when there was only time to rough up a special quick system of control for that particular material. Result has been a chaotic, confusing priority system more vexing to industry than would have been a rigidly restrictive but consistent control.

Stacy May, OPM research and statistics chief, says we are far from moving fast enough and our planned effort is not nearly what our share in the Allied cause should be; that our present rate of spending, about $10,000,000,000 a year, must be stepped up to $40,000,000,000 if the Axis is to be beaten.

Donald Nelson, OPM director of purchases, says that Hitler is spending at the rate of $50,000,000,000, and that the only way to beat him is for his opposition to spend more.

INSIDE DETROIT

Auto assembly rates exceeding 500,000 units per month will end this month; steel sources see heavy curtailment in number of 1942 cars. Stout Skycraft uses stainless steel in aircraft

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—When June becomes history, the auto industry will have bid goodbye for a long time to assembly rates in excess of 500,000 units per month. June production will approximate May's output of 550,000 units. Operations in July depend a good deal upon how well the various manufacturers were able to add material to schedules originally set to terminate at the end of June. In general, it can be said that volume producers will continue with a rush until the last week of July, then cut off sharply for the model changeover.

Employment in the auto parts supplying plants will soon dip sharply as commitments for the 1941-model season are wound up. Some of the smaller plants are already laying off, although much of this is due to difficulties in obtaining materials, especially nickel for plating. In early June, the employment index stood sixteen per cent over what it was at the year end, and at that time an abnormal situation prevailed.

In late summer and early fall there is bound to be considerable unemployment in the auto and parts industries before the slack can be taken up in defense work. A few weeks ago some car manufacturers were hopeful that 1942 assemblies could start out at a high rate in order to provide stop-gap work, and because no restriction was placed on how the curtailment program should be complied with so long as production for the first six months did not exceed the established figure. It now appears that materials shortages, especially steel and copper, will prevent the auto industry from coming within shooting distance of current rate of 135,000 assemblies per week.

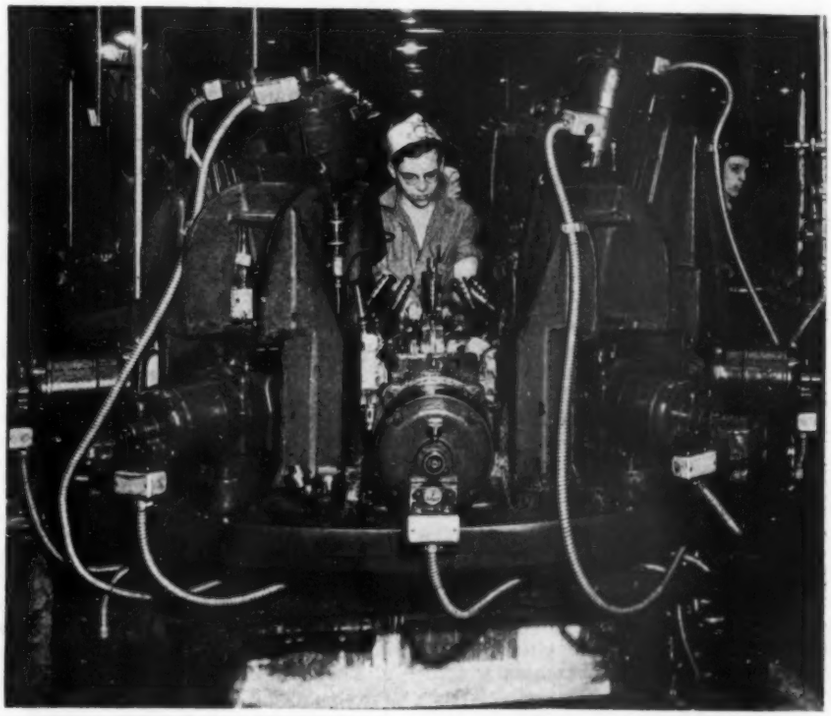
Metal Supplies Inadequate

Steel sources are of the opinion that the automobile industry has not been able to store appreciable quantities of metal for the early part of the 1942 season. For months, deliveries of certain catagories of material have been on schedules painfully close to consumption. While early in the steel famine, nickel steels gave trouble, auto companies quickly swung to other analyses and in fact the total tonnage of nickel steel was not large. In the outlook, however, there is the problem of disrupting mill schedules for non-defense purposes by huge orders for shipbuilding plates and sheets, shell steel, and railroad car steel. It is now understood that the needs of the rail carriers will be taken care of along with the shipbuilding requirements. Major steel companies are preparing their continuous rolling mills to handle greater thicknesses, and Great Lakes Steel is reported to be modifying its equipment to make plate up to 1-in. thick. Thus, automotive requirements for body sheets and frame steel must take second or third place. Orders for shell steel are currently raising havoc with bar-mill schedules, which in turn will delay automotive orders later on. This situation is likely to grow worse as new small arms ammunition plants and the 20 and 40-mm. shell plants get into production. Thus, while the recently issued General Steel Preference Delivery Order is not likely to affect the balance of 1941 model production, steel sources foresee a heavy immediate cut in car output for the 1942 series.

Preliminary reports of auto sales in May indicate a jump of at least 100,000 units over April, or close to 600,000. Thus field stocks were cut once more, because production ran about 550,000 units. All producers are not faring the same in the grab bag, but typical of the faster selling lines is the experience of one company. Field stocks were down to less than half a month's production; unfilled orders climbed to

PLASTICS FOR ALUMINUM

DETROIT—Translation of die-cast and plated auto trim into plastic designs is going forward, but at the moment it does not appear that a large volume of new molding presses will be required. There is talk of large orders pending for exterior and interior door handles covered with plastic, and of plastic headlining panels instead of cloth. But it still appears that the major interest in plastic molding presses lies in such uses as making fuse and cap parts for artillery projectiles. The use of plastics in these devices will save aluminum. Some 1,000-ton presses have already been purchased by Ford for the bomber parts plant. Briggs has placed some business for aircraft stamping presses; Chrysler is expected to come into the market very soon.



Fuzes for U. S. Army—*Stewart-Warner Corp., Chicago, recently delivered its 3,000,000th fuze to the U. S. Army (AM—Vol. 11, page 506f). In the shop (above) a trainee operates a special drilling machine which performs 11 drilling, reaming, tapping and chamfering operations on a fuze head. It is one of many automatic drilling machines in the fuze department*

Harris & Ewing

Inside Brooklyn—*The vast machine shop of the Brooklyn Navy Yard (above), at Brooklyn, N. Y., is running at top speed producing parts and materials. Although many news reels show completed battleships gliding gloriously down the ways, a machine shop like this is where they really come from*

Price Ceiling Placed On Nickel Bearing Metal

WASHINGTON—The eighth commodity price ceiling was put on scrap and secondary materials containing nickel last week by Leon Henderson's Office of Price Administration and Civilian Supply. The other seven: used machine tools, zinc scrap, aluminum scrap, scrap iron and steel, steel, combed cotton yard, and bituminous coal. Mr. Henderson said "the nickel ceiling was put on because of 'outrageous' prices charged in recent months for nickel content."

A premium is allowed any seller of scrap, called a "converter", who performs all of four functions: (1) sells directly to consumer; (2) pre-determines metal constituents; (3) on that basis sorts, grades, tests, packages scrap for consumption; (4) guarantees delivery in agreed amount and analysis. Quantity differentials are established. Maximum prices for nickel steel scrap are tied to the maximum steel prices set up in schedule number four. Persons wishing to sell at prices higher than top as a protection against loss may apply for approval of such sales. This will be granted only if purchase price was greater than the ceiling.

three weeks production, or five times what they were a year ago. There is increasing reason to believe that the more popular makes will be completely sold out before the end of the model run.

Stinson Has Ample Aluminum

A recent ruling by the government that manufacturers of light planes will be restricted in consumption of aluminum will not affect the operations of Stinson at Wayne, Mich. Sufficient aluminum for production of Model A trainers and cross country ships was obtained in an agreement reached in Washington last month, because of the importance of these planes in the civilian pilot training program. Stinson broke ground last week for a 55,000 sq. ft. addition to manufacturing plant, approximately doubling capacity. Most of the new space will be required for assembly purposes. Parts are being produced at Wayne for assembly at other Vultee plants. When the addition is completed about four months hence, the payroll will include approximately 1,000 workers. Further expansions are now being planned.

For production of aircraft reduction gears, Detroit Gear & Machine Div. of Borg-Warner Corp. is clearing out space in plant No. 1 in Detroit, and will soon install machinery. Approximately 150 men will be employed. The gears will be supplied to Curtiss-Wright at Caldwell, N. J., Detroit Gear & Machine becoming the fourth subcontractor on reduction gears for the engine manufacturer. Plant No. 2 has been making pumps and parts for Pump Engineering Service in Cleveland for about a year and a half. Further defense commitments by the Borg-Warner Div. would probably involve curtailment of domestic goods manufacture.

Manufacturing development work on the Stout Skycraft, a stainless steel training-type plane has proceeded to the point where the first jig-assembled ship is 75 per cent completed and it will be flight tested in September. A full scale wing is now undergoing tests at Wright Field.

Planes at Motor-Car Prices

William B. Stout, with the backing of Fred Fisher, formed the Stout Skycraft Corp. and planned to manufacture the plane early this year, with the idea of eventually offering the private flyer a ship at motor-car prices. The Air Corps has displayed much interest in the plane. A slow-speed (120 mi. per hr.) aircraft of this type if employed in quantities would have been able to raise havoc with or even prevented the German glider invasion of Crete, without being vulnerable to much faster fighters. The plane can also take off and land on a short deck, foreshadowing its employment in protecting freighters against submarines and surface raiders. Stout interests refuse to discuss the manufacturing plans now under consideration, but suggest that the original plans have been augmented considerably. Once the plane passes its acceptance tests, jigs and fixtures can be duplicated readily and operators trained rapidly in simple spot welding techniques. The ship is broken down into fifteen subassemblies of convenient size, so operators will not block each other in performing the various welding and jig assembling operations required.

Stout Skycraft Important

Stout Skycraft is important in the aviation world for a number of reasons: (1) stainless steel in thicknesses from 0.005 to 0.062 in. is employed instead of aluminum alloys; (2) all stressed and unstressed joints are seam or spot welded by the resistance method; (3) spot welding saves approximately 25 per cent of assembly time as compared with riveted designs, (4) the Stout wing weighs approximately two thirds as much as wings from conventional craft of similar size, and is very close in weight to a wood and fabric construction; (5) when tested to destruction, the wing will still withstand a flying load, in other words it may buckle but is still serviceable; and (6) the design and fabrication methods developed by Mr. Stout foreshadow important changes in construction of larger planes such as fighters and bombers, and the utilization of stainless steel in such ships to a greater degree than at present.

Most of the structure has been designed to accommodate the use of stainless steel, and patents have been secured or applied for upon practically all of the design features and manufacturing methods evolved.

WATCHING WASHINGTON

Need 300,000 machine guns for 30,000 airplanes—36,080 guns will be required for eight U. S. armored divisions. Navy requirements unknown. RFC awarded more money and more power

By BLAINE STUBBLEFIELD

WASHINGTON — Modern war of movement and aerial combat calls for machine guns on a vast scale. An estimate of the requirement can be made on the basis of the 30,000 combat planes on order for delivery by July 1942 to the Army, the Navy and forces opposing the Axis. Figuring a reasonable average of 10 guns apiece as teeth for these air fighters, the total would be 300,000 guns. You can run your figures up in proportion to the 80,000-plane program now projected, or to 100,000 and more in future if the war goes on. We supplied exactly 30,582 heavy Brownings to the AEF during the World War.

Yet in face of this large demand, Ordnance officers tell AMERICAN MACHINIST there is not and will not be any shortage of machine guns for mounting on aircraft. This requirement takes priority over machine gun (MG) production for all other purposes with a rating of A-7-B. The infantry, horse and mechanized cavalry, engineers, artillery; even the Quartermaster may get MGs.

The land forces, too, will probably get their MGs as fast as they can get organized to use them. Maj. Gen. Charles M. Wesson, Chief of Ordnance, speaking recently at the opening of General Motors' Saginaw Steering Gear Division, machine gun plant, said that this country, even in 1917, was well equipped to make this type of weapon. It must be assumed we are better equipped now.

U. S. Uses Browning

Mention in the press of Bren, Madsen, Lewis, Hotchkiss and other makes of MGs gives laymen the impression that the Army has several kinds. This is not the case. All those guns are foreign makes, tried out here but not in use. We use only the Browning, much improved over World War models, but basically the same. The Browning guns are made in only two calibers: .30 and .50 (hundredths of an inch). The Thompson gun is .45 cal.

How many MGs will be needed for the ground services is hard to calculate. You may assume a 2,000,000-man army as presently authorized, or a four or six-million-man force which might be authorized, and use your imagination. An armored division (tanks) of 12,694 men requires 4,510 MGs; we have two such divisions in the field; two forming; four more on paper; total MGs: 36,080. A triangular infantry division with 15,246 men requires 292 MGs. A horse cavalry division of 11,676 men is allotted 948 MGs. The Navy uses the same MGs as the Army, but no information is available as to quantity.

Some time ago the British wanted 500,000 MGs from the U. S. Certainly they received a considerable number of our surplus guns from World War I and just as certainly they have received a few new models. There are several U. S. companies making guns on British order now. One, according to records, is Buffalo Arms and another is High Standard Manufacturing Co. How many guns, on order with other firms, and arsenals, for the Army, and which will be diverted to Britain is not known.

Officially, the Army lists the following companies and contract amounts for .30 and .50 caliber MGs: Colt Patent Fire Arms, $15,770,549; Savage Arms, $27,166,283; Kelsey Hayes Wheel Co. $25,734,681; and four General Motors plants at Flint, Syracuse, Dayton, and Saginaw, $61,398,872. The Saginaw Steering Gear Division has opened its new plant and the others are coming into production about this time. Maj. Gen. Wesson said that Syracuse would build .30 cal. guns for aircraft; Dayton and Flint will turn out .50 cal.

STOCKPILES DISAPPOINTING

WASHINGTON — Disappointing results of the stockpile program are now generally admitted in Washington. Some piles have been built up, but we started too late; we began to accumulate reserves when things were already scarce. This lesson has caused some furious thinking among defense officials who are trying now to figure out what commodities, now reasonably plentiful, will be scarce at the arms production levels of 1942 and '43 and '44. They are drawing up plans to start stockpiles now of such items. It's already too late to do this painlessly; already there's no more than enough of anything for both civil and war needs. But it is possible to cut into civilian consumption before it's strictly necessary.

There are three methods of actuating machine guns: (1) gas entering a cylinder from a hole in the barrel, driving a piston back; (2) "blow-back" impact on the breach block; (3) recoil, in which the barrel, the barrel extension, and the bolt all move back through the mounting. All three accomplish the same things: ejection of the shell, reloading, and firing—in different ways.

There are several .30 caliber types. One is the water-cooled piece, used in large numbers by several branches of the Service, including the Infantry. Cooling by water, which is sometimes circulated through the jacket and a cooling element by hand-pump, permits the firing of long bursts.

Another .30 caliber is air-cooled, lightweight, with a high rate of fire, used exclusively by the Air Corps in airplanes. Firing in the air is limited not by the adequacy of air cooling but by the amount of ammunition the plane can carry and by brief exposure of the target.

A third .30 caliber MG is air cooled, for use by ground and mechanized troops, and in tanks.

The .50 caliber gun has been developed also in three broad types, for corresponding uses. The air-cooled gun has a high firing rate and is streamlined for mounting on airplanes; the water-cooled type is for anti-aircraft use; and the air-cooled heavy barrel, slow aimed fire, for attack on light armored tanks. All these guns, .30s and .50s, are recoil actuated and are belt fed.

More Money for RFC

A bill passed by the House and on its way through the Senate increases the lending power of Reconstruction Finance Corporation to $2,500,000,000, and authorizes the agency to do practically anything and everything. Specifically, RFC may: (1) produce, acquire, carry, sell, or otherwise deal in critical materials; (2) purchase and lease land, plants, equipment, machinery, arms, ammunition, implements of war (battleships, airplanes); (3) dispose of those things in any way; (4) manufacture all manner of defense articles itself; (5) manufacture, lease, purchase, or otherwise acquire railroad equipment; and (6) acquire and operate facilities for training pilots. This money and authority will carry only a minor part of the new plant expansion program now getting under way. These actually limitless powers would be used only in extreme cases of failure, refusal or slowness of industry to deliver defense goods. Plants built by RFC would be exempt from taxation, could be leased to industry. It authorizes loans to foreign corporations.

More Hours Lost by Accidents Than Strikes

WASHINGTON—The accident loss of man-power in 1940 was more than 20 times the loss due to strikes. In an average normal peak time year 1,500,000,000 man-hours of production are lost through accidents. This would produce something like 45 battleships. In 1940 the accident time loss in the aviation industry alone was 580,518 days. The U. S. Ordnance Department, which is working on the idea that the prevention of accidents in defense plants is a step to our national safety, is tackling problems of worker safety and health and plant protection.

Accidents have become a serious problem, particularly in plants which are taking over defense work to which they are unaccustomed. New workers must be trained in safety technique.

The Ordnance Department has an already established safety program in all its own plants. The problem for private plants having Army contracts will be tackled by a new group of civilian inspectors. They will include men with experience in large fire departments and casualty companies, who can put the finger on danger spots. These men will look for things like a sagging steamline which might result in a slug of water being thrown into the operating division of a plant and causing great damage. Explosive dust will be watched as a fire, health and explosion hazard. Bad installation of equipment, sprinkler systems not examined often enough will be remedied.

The Ordnance's Plant Security Division, in cooperation with the Army Medical Corps and the Public Health Service, has just completed a survey of industrial health hazards with particular reference to toxic effects of ingredients and solvents in ammunition loading. Health protection and diagnostic procedures, of use both to government plants and private industries, will result.

Dedicate New Gage Plant At Pratt & Whitney

HARTFORD, CONN.—Pratt & Whitney, Div., Niles-Bement-Pond Co., Hartford, Conn., dedicated its new 48,000 sq. ft. gage building to National Defense recently. Clayton R. Burt, president of the company, indicated in a speech at the dedication ceremonies the importance of precision gages to the manufacture of guns, tanks, planes and hundreds of other items needed in vast quantities for national defense. The new building adds 48,000 sq. ft. to the organization's gage-making facilities. Brig.-Gen. G. M. Barnes, ordnance office, received a special gage from Mr. Wm. J. Walch, oldest employee in the gage department, as a memorial of the occasion.

JAPAN NEEDS MACHINERY

WASHINGTON—The output of machinery in Japan, it is indicated here, remains far below requirements; it is likely that all manufacturers will be placed under control of one central producing organization. Government authorities ordered a nation-wide inventory of machine tool stocks.

British Empire Increases Machine Tool Production

LONDON—Unlike World War I, when the British Colonies depended on the home country for their machinery supplies, the Colonies today are producing every kind of weapon of war, with the temporary exception of tanks. Before this could be done widespread production of machine tools was necessary. These are being manufactured in increased quantities in the various overseas areas. In Australia the two most industralized states, New South Wales and Victoria, have made no purchases of British machine tools for two or three years. These figures do not include private purchases. In South Africa most of the essential tools are being manufactured by South African industry, for the production of armored cars, field artillery, rifles, shells, bombs and small ammunition, and 3,000 skilled and semi-skilled men between 18 and 45 are being trained every six months. Canada's industrialization has been recognized for a decade.

WAGE CEILING UNLIKELY

WASHINGTON — Some sort of ceiling on wages is not ruled out in Washington. New dealers and defense officials agree that as long as profits and prices are allowed to rise, wages have got to go up too. Many of them would have preferred to freeze wages at substantially the levels of a few months ago, siphoning off the profits with a string of compulsory or voluntary price cuts. For the present, it is unlikely any formal wage ceiling will be proclaimed. Prices will be frozen at levels precluding wage increases.

NEW PROPELLER PLANT

TOLEDO, OHIO—The American Propeller Corp., a subsidiary of Aviation Corp. of America, will operate a new 500,000 sq. ft. airplane propeller plant to be constructed here with the aid of government funds amounting to $8,700,000 for the first unit of the plant. An aviation experimental plant will also be built by Aviation Corp., separate from the government-built plant; it represents an investment of $500,000. More than 400,000 highly skilled workers will be employed in the propeller industry. The output of the plant is expected to exceed 2,500 pressed seamless steel tubing propellers a month at the start, ultimately reaching 8,000 blades per month.

U. S. Government Contracts Awarded to Metal-Working Firms

(Does not include contracts under $100,000)

Source	Agency	Commodity	Amount
Crane Co., Washington, D. C.	Navy	Valves	$350,000
Selas Co., Philadelphia, Pa.	"	Hot air heaters	138,440
Walworth Co., Greensburg, Pa.	"	Valves	125,000
Allis-Chalmers Mfg. Co., Milwaukee, Wis.	War	Tractor parts	113,401
Albertson & Co., Inc., Sioux City, Iowa	"	Elec. drills	104,670
Baldwin Southwark Div., the Baldwin Locomotive Works, Philadelphia, Pa.	Navy	Plate edge planing machines	105,500
Continental Machines, Inc., Minneapolis, Minn.	War	Contour metal sawing machines	207,765
Allis-Chalmers Mfg. Co., Milwaukee, Wis.	TVA	Generators	930,388
Curtiss-Wright Corp., Airplane Div., Buffalo, N. Y.	War	Airplanes	13,360,562
Douglas Aircraft Co., Inc., Santa Monica, Calif.	"	Airplanes	43,521,300
Boeing Aircraft Co., Seattle, Wash.	"	Airplanes	17,201,352
Walworth Co., New York, N. Y.	Navy	Steel valves	366,024
The Midvale Co., Philadelphia, Pa.	"	Rudder bearing forges	447,134
Bolt & Nut Div., Republic Steel Corp., Cleveland, O.	"	Steel rivets	114,300
American Shim Steel Co., New Kensington, Pa.	War	Strip steel	152,445
The Bossert Co., Inc., Utica, N. Y.	"	Cartridge cases	1,290,000
Norris Stamping & Mfg. Co., Los Angeles, Calif.	"	" "	942,000
Struthers Wells-Titusville Corp., Titusville, Pa.	Navy	Steering gears	635,742
Star Electric Motor Co., Bloomfield, N. J.	"	Generator sets	266,561
American Monorail Co., Cleveland, Ohio	War	Cranes and accessories	313,182
"Quick-Way" Truck Shovel Co., Denver, Colo.	"	Truck-cranes	705,604
Michigan Tool Co., Detroit, Mich.	Navy	Gears	107,010
Reed-Prentice Corp., Worcester, Mass.	War	Lathes	2,607,300
J. I. Case Co., Racine, Wis.	"	Tractor-mowers	166,239
Bogue Electric Co., Paterson, N. J.	Navy	Motor-generator sets	125,460
Baldwin Locomotive Works, Baldwin Southwark Div., Eddystone, Pa.	TVA	Turbines	935,850
General Electric Co., Schenectady, N. Y.	Navy	Motor sets	975,698
American Bosch Corp., Springfield, Mass.	War	Magnetic assys.	325,710
International Harvester Co., Washington, D. C.	Navy	Trucks and chassis	211,700
United Aircraft Corp., Vought-Sikorsky Aircraft Div., Stratford, Conn.	"	Airplanes	26,679,070
United Aircraft Corp., Hamilton Standard Propellers Div., East Hartford, Conn.	"	Propellers	5,688,138
Bendix Avia. Corp., Scintilla Magneto Div., Sidney, N. Y.	War	Distributor assys.	450,887

NAMES in the NEWS

John C. Arnoldy has been elected president, Warman Steel Casting Co., Los Angeles. He succeeds the late Charles J. Wild.

C. S. Bennett has retired as president, the Stanley Works, New Britain, Conn., and is now chairman of the board. Mr. Bennett has been associated with the Stanley Works for the past 50 years. Richard E. Pritchard succeeds him as president.

Robert T. Bowman has been appointed director of public relations, John A. Roebling's Sons Co., Trenton, N. J.

L. H. Burnett, a pioneer in promotion of the safety movement in industry and senior vice-president of Carnegie-Illinois Steel Corp., retired after 40 years of service. Mr. Burnett has been associated with Carnegie-Illinois Steel Corp. and its predecessor, Carnegie Steel Co. since 1901.

James Coombe has been elected president, Wm. Powell Co., Cincinnati while Harry H. Coombe has been elected chairman of the board and treasurer.

D. L. Davis has been appointed factory manager in charge of engineering and production in the pump division, Tuthill Pump Co., Chicago. He succeeds M. W. Huber who resigned.

Gus C. Detlefsen has been appointed general manager, Bridgeport division, Crane Co., succeeding Albert E. Macdonald who retired after 50 years of service. Mr. Detlefsen was formerly superintendent of service at Bridgeport and has just recently returned from England where he managed Crane's Ipswich plant. He also managed Crane's Paris division before the German invasion.

M. R. Dill has been appointed a director, the Lincoln Electric Co., Cleveland, Ohio.

A. F. Dohn, formerly vice-president in charge of tool steel sales, Allegheny Ludlum Steel Corp., has retired from active business.

H. V. Erben, assistant manager of the central station department, General Electric Co. since Jan. 1, 1939, has been appointed department manager. M. O. Troy, former manager, will continue as commercial vice-president.

Laurence M. Ewell has been named general manager, eastern division operations, Link-Belt Co., Chicago, Ill.

W. T. Gray, formerly assistant superintendent, Becton, Dickinson & Co., Rutherford, N. J., has been appointed factory manager, instrument div., Thomas A. Edison, Inc., Orange, N. J.

Carnegie-Illinois Engineer

THOMAS R. MILLER

Crane Co. V-P

V. P. RUMELY

Ralph M. Hoffman has been elected vice-president in charge of sales, Link-Belt Co., Chicago.

E. N. Hommel, since 1929 vice-president, O. Hommel Co., Pittsburgh, has been elected president, succeeding his father, the late Oscar Hommel.

Louis N. Hunter, formerly manager of research, National Radiator Co., Johnstown, Pa., has been elected vice-president.

F. C. Jones, formerly on the staff of the assistant to the president, Handy & Harman, New York, has been appointed manager of the Bridgeport, Conn. plant. J. L. Christie has been named metallurgical engineer.

George T. Kilmon has been elected assistant secretary and Edward M. Martin assistant treasurer, the B. F. Goodrich Co.

Roy S. Laird has been appointed sales manager, Ohmite Mfg. Co., Chicago.

Charles E. McManus, chairman of the board, has been elected president, Crown Can Co., Philadelphia. He succeeds L. Frederick Gieg who resigned to become president, National Can Corp.

James H. Maguire, works manager, Haynes Stellite Co., Kokomo, Ind., a unit of the Union Carbide & Carbon Corp., has retired but will continue with the company in a consulting capacity. F. T. McCurdy has been named general superintendent in charge of production and operating departments, after having served since 1929 as superintendent of the plant. J. R. Brown, formerly production manager, has been named assistant superintendent.

Thomas R. Miller has been appointed Chicago district industrial engineer, succeeding G. A. Whitehurst, Carnegie-Illinois Steel Corp. Mr. Whitehurst was recently transferred to Pittsburgh, where he became assistant to the chief engineer of the company.

Samuel W. Moore, formerly assistant master mechanic, Jessop Steel Co., Washington, Pa., has been appointed construction engineer in charge of plant rehabilitation and new construction.

E. G. Price has been named general superintendent, Lorain, Ohio plant, the National Tube Co., U. S. Steel Corp. subsidiary. He succeeds Earl W. Brown, superintendent for the past eleven years, who goes to Pittsburgh where he will join the staff of E. N. Sanders, vice-president in charge of operation.

Jesse J. Ricks, formerly president, Union Carbide & Carbon Corp., New York, N. Y., has been elected chairman of the board and Benjamin O'Shea, formerly vice-president, has been named president. James A. Rafferty, a vice-president, was elected to the board of directors and Robert W. White, secretary and treasurer, has been named vice-president.

V. P. Rumley, formerly works manager, Crane Co., Chicago, has been named vice-president in charge of manufacturing. He became associated with the Crane Co. in 1937.

Peter E. Sance has been named works manager, Allenport Div., Pittsburgh Steel Co., Pittsburgh. He succeeds S. N. Gilmore who has retired.

J. B. Savits, regional chairman for Massachusetts of the Emergency Defense Training Committee, the American Society of Tool Engineers, has been appointed an adviser, the "Training Within Industry" division of the Office of Production Management.

Fernald S. Stickney has been appointed vice-president and chief engineer, Instrument Specialties Co., Inc.,

E. D. SPICER

I. A. ROSE

Their appointments as assistant to the vice-president in charge of manufacturing, General Electric Co., and vice-president in charge of manufacturing, Edison General Electric Appliance Co., Chicago, Ill., respectively, were announced in these columns

Little Falls, N. Y. Mr. Stickney was formerly instrument designer, Westinghouse Electric & Mfg. Co., Newark, N. J.

Paul T. Skove, Perfection Stove Co., Cleveland, Ohio has been elected president, Cleveland Purchasing Agents' Association. Harry Markle, of Harris-Seybold-Potter Co., has been named first vice-president and W. S. Avery of Elwell-Parker Electric Co., has been named second vice-president.

Donald F. Walker, general sales manager, Combustion Engineering Co., Inc., New York, N. Y., has been named vice-president in charge of sales.

M. A. Wick has resigned as vice-president in charge of finance and as a director, Republic Steel Corp., Cleveland.

Harry L. Wilcox, assistant chief engineer, the Electric Controller & Mfg. Co., is now president, the Cleveland Engineering Society. Other officers are: Vice-president, Walter C. Sutton, Lindsay Wire Weaving Co.; and Treasurer, Carlton R. Sabin, president, Sabin Engineering Co.

PLANT EXPANSION

The Merz Engineering Co., Indianapolis, Ind., is now operating a new plant which comprises 36,000 sq.ft. of floor space. The company, which manufactures gages, special machine tools, gears and fixtures, employs 200 persons and is expected to add 200 other skilled craftsmen by August.

The Ranger Engineering Corp., engine manufacturing division of the Fairchild Aviation Corp., will expand its aircraft factory at Farmingdale, L. I. at a cost of $1,478,800.

BUSINESS ITEMS

Algonquin Airparts, Inc., Bridgeport, Conn., has recently been organized with a capital of $25,000. James B. Helme, formerly head of the Kenape Aircraft Motors, Mattawan, N. J., is president of the new company. Tyler Clark, who has been associated with the Vought-Sikorsky Div., United Aircraft Corp., is production manager.

American Precision Products Co., Los Angeles, Calif., has been organized by Wilbur A. Ellmore.

The Dardelet Threadlock Corp., 55 Liberty St., New York, N. Y., has moved to the Machinery Building, East Grand Boulevard, Detroit, Mich. Arthur F. Hebard resigned as president of the company, and E. B. Jackson, formerly chairman of the board, has been elected president.

D. & F. Tool and Machine Works, Los Angeles, Calif., has been organized by William P. Draper and Joe W. Fitts.

Moore Rotor-Brake, Inc., has been organized in Fresno, Calif.

Pacific Aero Development, Lawndale, Calif., is the firm name under which Harold E. Goodell, Donald F. Walter and Roland F. Lindert have obtained a certificate to conduct business.

Shelton Aircraft Corp., San Diego, Calif., has been organized with a capital of $1,000,000.

Welded Aircraft Parts Co., Los Angeles, Calif., has been organized by Arnold H. Rahn and Lee W. Roork.

Woolard Aircraft Corp., San Diego, Calif., has been organized with a capital of $500,000.

OBITUARIES

Glenn Harrison Barnard, general manager, Electrodynamic Works, the Electric Boat Co., Bayonne, N. J., died recently.

Herman K. Beach, 59, founder and president, Metal Goods Manufacturing Co., Bridgeport, Conn., died on May 29.

Wm. S. Bidle, 68, president, W. S. Bidle Co., Cleveland, died on May 11. He was a former president of the American Society for Metals.

William H. Cadwell, 78, president of the Beaton Cadwell Manufacturing Co., New Britain, Conn., died on May 21.

Thomas H. Frazier, 77, former owner of the Detroit Brass Co. died recently.

Irwin A. McIntyre, 55, one of the founders of the Milwaukee Steel Foundry Co., died on May 22.

William H. Morris, 43, vice-president since 1932, Edward C. Ward Sons Co., Pittsburgh, died on May 21. He had been associated with the organization since 1916.

Horatio A. Porter, 86, inventor of machining devices and tools, died at Holyoke, Mass., on May 20.

J. F. Roche, Jr., 35, vice-president of the Binks Mfg. Co., died May 28.

Oliver W. Upson, 66, vice-president, Upson-Walton Co., Cleveland, died recently.

Warren H. Walker, 61, vice-president, the Walker Mfg. Co., Racine, Wis., died recently. He and his brother, Willard Walker, founded the company in 1910.

Oliver B. Zimmerman, 68, who last year was awarded the Cyrus Hall McCormick gold medal for outstanding work in agricultural engineering, died recently. He joined the International Harvester Co. in 1911 and remained there until his retirement in 1935.

MEETINGS

American Society of Mechanical Engineers. Semi-annual Meeting, Kansas City, Mo., June 16-20.

American Society for Testing Materials. Annual meeting to be held in conjunction with an exhibit of testing apparatus at the Palmer House, Chicago, Ill., June 23-27.

Conference on Industrial Relations. Silver Bay on Lake George, N. Y., July 23-26.

SHOP EQUIPMENT NEWS

Pratt & Whitney Announces Four Electrolimit Instruments for Precise Measurement

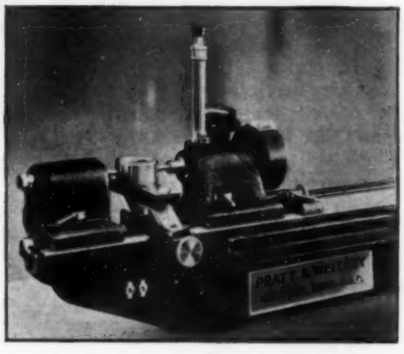
Universal comparator checks internal diameters over wide range of sizes

Four new instruments manufactured by Pratt & Whitney Div., Niles-Bement-Pond Co., West Hartford, Conn., are said to eliminate personal error and achieve an ultra-high degree of accuracy for checking measurements. All based upon the "Electrolimit" principle, they include an "Electrolimit" universal comparator for internal diameters, a standard measuring machine with an "Electrolimit" pressure tailstock for checking gages and tools to an accuracy of 0.00001 in.; a machine for checking thread leads; and an "Electrolimit" snap gage.

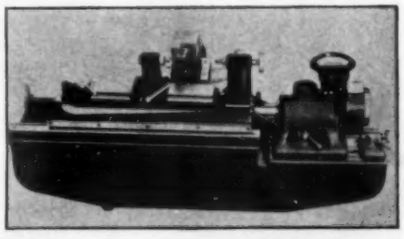
Internal dimensions over a wide range of sizes can be measured with the "Electrolimit" universal internal comparator. Capable of revealing out of round, taper and bell-mouth conditions, this instrument is particularly well suited for checking ring gages and similar parts. By taking ordinary precautions in such essential details as cleanliness, temperature and operating technique, this comparator may be read within an accuracy of 0.00002 in. It covers a range of sizes from ½ to 10 in. diameters inclusive, and occupies a floor space only 18x20 in. plus a 13-in. circle for the indicator stand. It operates from any 110 volt 60 cycle source having reasonably constant voltage and frequency regulation.

Errors due to the human element in measuring are said to be completely eliminated with the P. & W. standard measuring machine. This instrument, which reads directly to 0.00001 in., can be universally used for checking gages, tool parts and any physical dimension within the range of the instrument.

The machine consists essentially of a master bar, a dividing screw, and a means of controlling measuring pressure, all mounted on a rigid bed. The master bar is graduated at each inch interval, providing a permanently accurate setting. The graduations are extremely fine hair lines, visible only through a microscope. The measuring



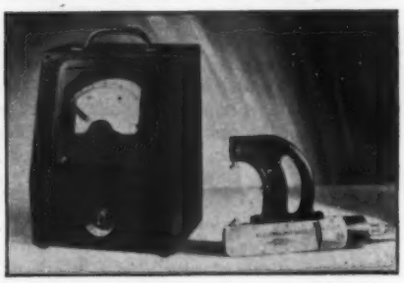
P. & W. standard measuring machine reads dimensions directly to 0.00001 in.



Leads of threads can be checked to 0.000025 in. on this device

head includes a microscope, with two hair line graduations used when setting to match the hair line on the master bar, and a precision dividing screw which subdivides one inch. Measuring pressure is controlled by an "Electrolimit" pressure tailstock.

Exceptional accuracy, speed, range and flexibility are said to be provided with the lead testing machine. This machine, which occupies a bench space of 37x17 in. and stands 59 in. high, will handle parts up to 4¾ in. in diameter with a thread length of 4 in. and an over-all length of 8 in.



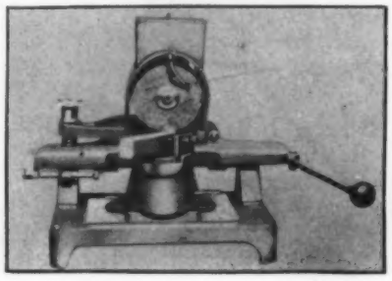
Advantages of both a comparator and a snap gage are combined in this "Electrolimit" snap gage

The measuring head of this device is identical with the one on the standard measuring machine, except that the microscope is omitted. It is claimed to read accurately to within 0.000025 in. Tapered threads as well as straight threads may be checked by correctly positioning the swivel work supporting table. This device is a direct reading instrument, not a comparator. Regular equipment includes a set of seven ball points for 4–80 threads per inch.

Advantages of both a comparator and a snap gage are combined in the "Electrolimit" snap gage developed. Personal errors are eliminated, the gage is light and easy to handle, and the electric circuit amplifies any errors into an easily read needle movement on a dial. The result is a considerable saving of time with no loss in precision. Two gage bodies and several frame sizes permit checking diameters from ½ to 6 in.

Drafto Chip Breaker Grinder Is for Carbide Tools

The Drafto Co., 112 Walnut St., Cochranton, Pa., has placed into production a new Model A chip breaker grinder. This machine, for grinding chip breaker grooves in carbide metal



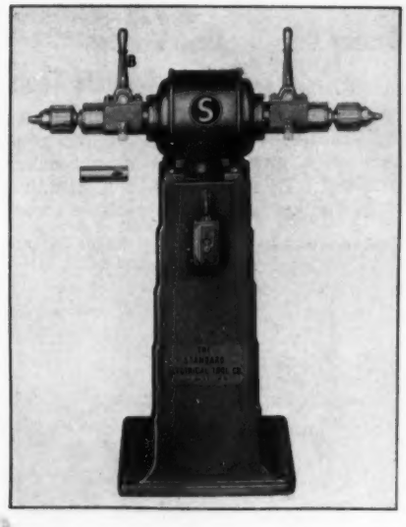
cutting tools, has been designed to simplify correct tool adjustment to any angle necessary for accurate grinding. A universal vise with dual locking feature is equipped with a ball adjustment to permit setting of the tools to any angle.

Grinding operation is performed by a diamond cutting wheel mounted directly on the shaft of a ¼-hp., 110-volt, 60-cycle a.c., 3,450-r.p.m. motor. The motor is mounted directly on an actuating slide, and in operation is moved horizontally across the machine. The horizontal motion of the arm, shown at right of machine, carries the diamond wheel across the face of the tool, grooving the tip. Depth of cut is adjusted by knob on motor hinge bracket. This knob is graduated for micrometer adjustment.

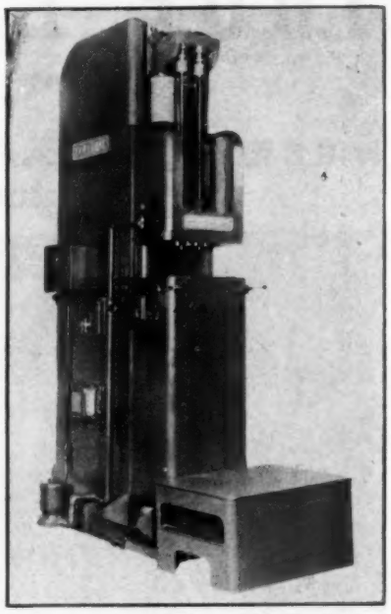
A tank for holding kerosene is mounted directly above the diamond wheel guard; kerosene is applied by means of a tube inclosing a wick which supplies correct amount of lubrication. Diamond wheels can be supplied in interchangeable 4- or 6-in. diameters. Type of motor can be varied to meet customer specifications.

Double-End Speed Lathe Made by Standard Electrical

The Standard Electrical Tool Co., 1940 W. 8th St., Cincinnati, Ohio, have added to their line of speed lathes a double-end arrangement as illustrated. The spindle at each end can be started and stopped without interfering with the operation at the other end. Combination clutch and brake can be actuated by hand or by foot; simultaneous action disengages clutch and applies brake, instantly stopping work spindle, while the motor continues running. Increased production results from the facility of quick starting and stopping the work spindle. Since each work spindle is independent of the motor shaft and the motor can operate at all times, no time is lost in bringing the motor up to speed. Motor is operated by toggle switch at front of machine. Available in sizes of ½, 1 and 2 hp. with any standard motor speed.



Improved Colonial Pull-Up Broaches Have Higher Capacities for Smoother Operation



Peak capacities of the entire line of pull-up broaches manufactured by Colonial Broach Co., 147 Jos. Campau, Detroit, Mich., have been substantially increased over former types to provide greater reserve power and smoother operation when tooling is adapted for the normal capacities of the machines. Designed primarily to obtain maximum production in machining round and splined holes, these new machines range from 6 to 25 ton capacities, and from 36 to 50 in. stroke. All machines provide completely automatic hydraulic handling of the broach. The machine platen and puller brackets are large, providing ample space for pulling two or more broaches at one time. Provision is made for mounting spiral broach drive heads.

The operating cycle is as follows: the broach is held in the bottom of the handling mechanism by locating bushings. When the operator starts the machine after placing the part in position over the pilot end of the broach, a handling cylinder located in the base of the machine advances the broach through the platen. An automatic puller located in the pull bracket then engages the broach. Loading and unloading the machine is easy, since the part is merely dropped over the top pilot of the broach. The machines are equipped with dual hand control, making it impossible for the operator to start the broach unless both hands are on the operating levers.

A hydraulic tank of ample capacity is provided for efficient operation. An oil level gage mounted on the side of the machine and readily visible from the operator's position indicates the available supply of hydraulic oil. All machines are equipped with heavy-duty large volume coolant pumps.

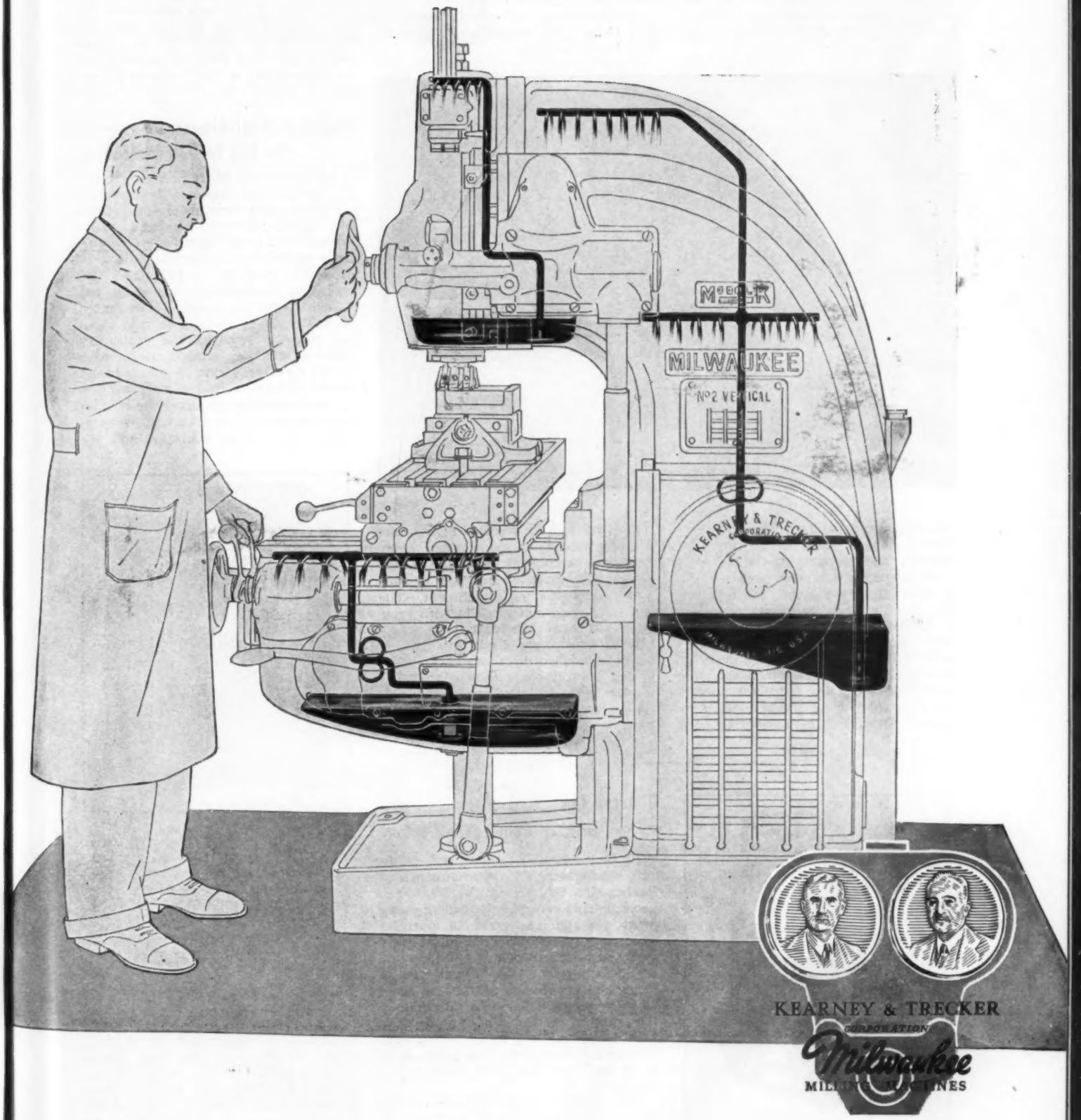
G. E. Gage Measures Thickness Of Non-Magnetic Metals

Applicable to the thickness measurement of any non-magnetic metal when only one side is accessible, even if the non-magnetic metal is backed up by a magnetic metal, a new type of electric gage has been announced by the General Electric Co. at Schenectady, N. Y. Although designed especially for measuring the wall thicknesses of hollow aluminum airplane propellers, the gage can be used to measure thicknesses of brass sheeting, copper tanks, and large pipes. Thicknesses up to 1½-in., depending upon the electrical resistivity of the metal, can be measured within an accuracy of 5 percent.

The gage consists essentially of a bridge circuit, voltage amplifying equipment and an indicating instrument. The bridge circuit comprises two inductances with U-shaped cores and a differential transformer. The inductances serve as a gage head and an adjustable balancing head. The gage head, when placed against a non-magnetic metal, sets up eddy currents within the metal which change the impedance of the head and affect the circuit bridge balance. Eddy currents increase with the thickness of the metal. Effects of these eddy currents upon the circuit bridge, as shown by deflection of the indicating scale, are plotted upon a master curve for known thicknesses of a specific metal within the desired thickness range. The gage head then is placed against the unknown thickness of that same metal and the scale deflection read. It is essential that the contour of the test piece be the same as that of the pieces of known thicknesses from which the master curve was obtained.

Lubrication—vital to the life of any machine—is provided in the Milwaukee Milling Machine by automatic pressure pumps in the column and knee, and in the sliding head on vertical machines. Automatic pump lubrication of this type requires only a minimum of attention.

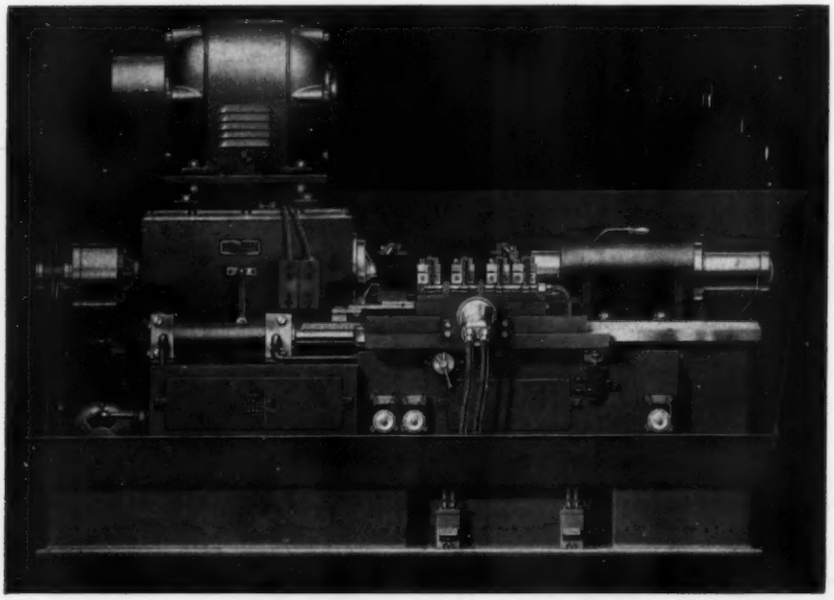
KEARNEY & TRECKER CORPORATION • Milwaukee, Wis., U. S. A.



MILWAUKEE MILLING MACHINES

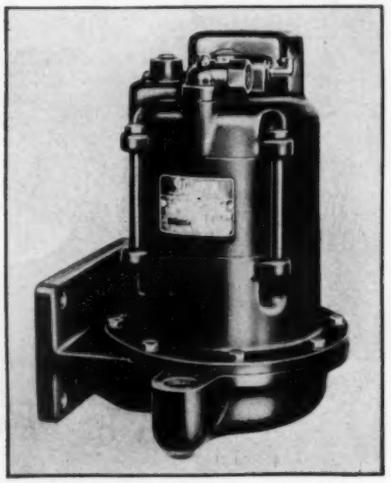
Sparks Semi-Automatic Lathe Machines Shell from 75-mm. to 155-mm.

The new semi-automatic Hydra-Feed lathe of Sparks Machine Tool Corp., 35 Park Hill Ave., Norwalk, Conn., is especially suitable for all operations on all size shell bodies from 75 mm. to 155 mm. inclusive, and for rapid machining of similar parts. The lathe is equipped for automatic operation with hydraulic feeds and hydraulically operated duplex brake and clutch for starting and stopping the spindle.



In the operation, the shell forging is inserted in the lathe, the tailstock live spindle is hydraulically traversed to locate the shell on the mandrel, at which time the spindle is automatically started by the hydraulically operated clutch, and the carriage with the slide controlled tools are fed hydraulically until the outside of the shell is completely finished. Simultaneously, the rear slide tools face the base end and cut-off the open end to length. Carriage and rear slide tools are returned to respective starting positions, and the spindle is automatically stopped when the operation is finished.

Specifications: swing over ways, 19 in.; swing over carriage, 10 in.; extreme distance between chuck or expanding arbor and tail centers, 33 in. The tool carriage is of heavy ribbed design with extra wide bridge to support multiple tooling attachment. The bed is of rigid construction with cross girths at close intervals. All longitudinal and cross feeds are quickly changed by feed dials located on front of the control box. Independent hydraulic feeds for attachments are also controlled by dials mounted on control box.



Gilbarco Centrifugal Pump Handles Chip-Laden Coolant

Well built, durable, centrifugal pump unit manufactured by Gilbert & Barker Mfg. Co., Springfield, Mass., delivers cutting oil or compound the moment the pump begins to operate. The pump has no metal-to-metal contact, and permits the handling of liquids charged with filings, small chips and abrasive impurities as large as 0.035 in. diameter. Installation of the pump is by means of four bolts in the heavy mounting flange which surrounds the inlet port. Capacity is 13 to 15 gal. per min., full flow, ¾ in. discharge.

The pump, ¼-hp. explosion-proof motor and motor switch are built as an integral unit. The motor, which has a notably low starting torque, has no brushes or commutator. Only half the usual number of bearings are required, and the lower bearing is grease packed. A positive mechanical seal between the motor and the pump eliminates any possibility of cutting oil or compound reaching the motor. The height is 13 in.; diameter is 8¼ in.; inlet flange dimensions are 4½x7½ in. Bolt holes of flange, 17/32 in. dia., are 3¼ and 6¼ in. on centers. The flange can be furnished with bolt holes drilled in any position within limits of flange.

Square D Multi-Breaker For Use On 230 Volts A. C.

A new industrial Multi-Breaker for use on 230-volt a.c. systems is compact, and has a dust-resisting inclosure with felt gasket between box and cover. Both 2- and 3-pole forms are available from Square D Co., Detroit, Mich., in capacities from 15 to 100 amp. The operating mechanism, including the die-cast external handle, is mounted on the cover of the box so that when the cover is removed the entire interior of the box around the breaker is left free for wiring. A white target signal appears behind a glass window in the nameplate whenever the breaker trips out due to a short circuit or overload. The front operation of the breaker unit permits close ganging of units. There is provision for padlocking. To eliminate the possibility of the breaker causing single phasing of polyphase circuits, the breaker units are all common trip. An overload on any pole causes all poles to trip simultaneously.

No. 677 Stanley Grinder Has "Flud-Lite" Eye Shields

Especially suited for use in industrial shops for keeping edge tools sharp, the new No. 677 grinder of the Stanley Electric Tool Div., New Britain, Conn., is equipped with two 7 x 1 in. wheels. One of these is for tool grinding, the

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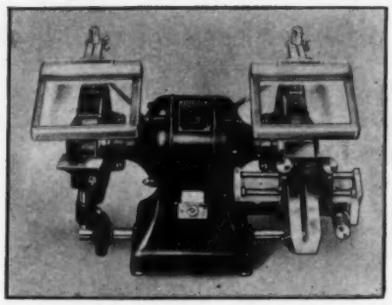
other for general grinding. Stanley "Flud-Lite" eye shields are furnished with the machine, and are connected so that the two bayonet-type light bulbs go on or off as the grinder switch is operated. The special 1/3-hp., ball-bearing motor operates at correct slow speed so that edge tools will not have temper burned out. Wheels are protected with guards and covers, and have exhaust outlets. The grinder is available for a.c. or d.c. and has a maximum speed of 1,800 r.p.m.



Grinder Announced by Machinery Manufacturing Has 350-Deg. Horizontal and Vertical Swivel

A new combination universal grinder for all types of tool, cutter and reamer grinding, internal and external as well as surface grinding, has just been introduced by Machinery Mfg. Co., Dept. AM-441, 1915 E. 51st St., Vernon, Los Angeles, Calif. The machine has several important new features incorporated in its design, foremost among which is the fact that the motor carrying the grinding wheel swivels through 350 deg. vertically, and the column on which the motor is mounted also swivels through 350 deg. horizontally. Thus the center of the motor and column are positioned to align either cylindrical or surface grinding wheels with the center of the bed, providing full grinding range without elongation of the ways.

When used as a surface grinder, the machine accommodates a 6 x 10 in. magnetic chuck, and will grind a complete area of 6 x 16 x 7½ in. above the table. Swing is 8 in. It will accommodate 16 in. between centers, with a hand longitudinal feed of 16 in., 8-in. vertical travel of motor, and 6-in. in-out travel of column.

Extreme rigidity has been maintained by making the surface grinder an integral part of the machine instead of the customary extension shaft. The machine table is traversed by a two-speed handwheel and may be operated from either front or rear. Carbide tools can be ground by tilting the motor and swiveling the column. Provision is also made for a coolant pump so that the machine can be used as either a cylindrical or surface grinder.

Dayton Rogers Die Cushion Exerts Heavy Ring Pressure

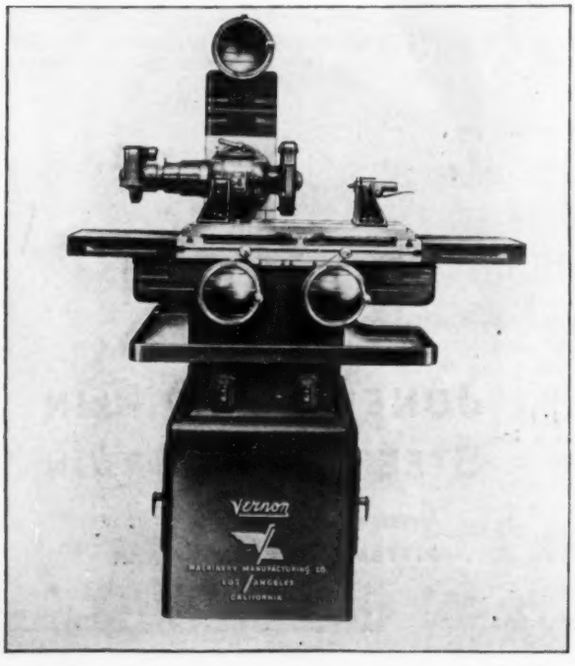
The Dayton Rogers Mfg. Co., 2830 13th Av. So., Minneapolis, Minn., has produced a new design of pneumatic die cushion designed for extremely heavy ring-holding pressure on large double-throw, single-crank presses, and double-crank, double-throw presses. Known as Model CCC, these cushions are furnished in double tandem units and are supplied with a combination regulating valve and pressure gage that controls and regulates all working draw ring holding pressures. Working parts of the cushion cylinders are shielded against pierce slugs or loose parts, which cannot come in contact with the cushion unit.

On these larger tandem cushions a pit is usually provided on the presses. Cushion equipment comes complete with a remote centralized lubricating block or header; this centralized lubricating block is furnished with leads to carry the lubricant to the desired location on the individual cushion cylinders. This type of pneumatic die cushion equipment has ring holding pressure ranging from 25 to 100 tons controlled by the automatic reducing regulating valve.

Despatch CF Furnace Adaptable to Toolroom Work

New CF furnaces announced by Despatch Oven Co., Minneapolis, Minn., are claimed to be more adaptable than the older furnaces to toolroom tempering and drawing work, to the heat-treatment of aluminum rivets and other aluminum alloy castings and parts, to the preheating of aluminum billets before forging, to the heat-treatment of magnesium alloy castings, and to general production work requiring a temperature range from 300 to 1,200 deg. F.

The body construction of the furnace, heavy steel exterior with high-grade efficient insulation, has been made heavier, and heavy duty lift doors have replaced former swing type doors. Fan capacities have been increased and method of interior heat distribution and circulation has been modified to give better uniformity. In the gas-heated furnaces, standard atmospheric burner and combustion chamber equipment is furnished, along with Despatch "Controlled Combustion" that assures high combustion



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Why not let Sunoco help in boosting the P-Q of *your* machines? Test it in your own plant . . . let it prove its ability to give *"all out aid"* to hard-pressed machine-tools. Send for your copy of "P-Q—Your Key to Increased Production." Write Dept. E-

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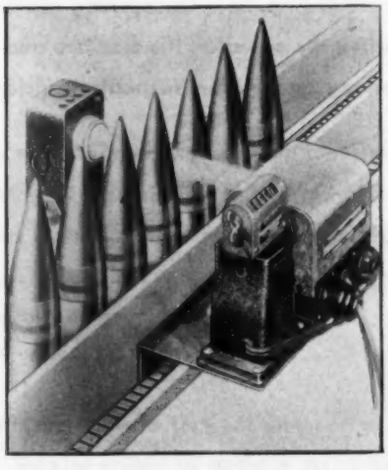
efficiency under all operating requirements. In the electric furnaces, open coil long-life heating elements of nickel chromium are mounted on a suitable frame work with a minimum of refractory support.

Durant Productimeter Counts Photoelectrically

A new photoelectric counting unit manufactured by the Durant Mfg. Co., 1945-B No. Buffum St., Milwaukee, Wis., has an important advantage in that the counter need not be installed at the point of contact. It can be placed in an office where the record of production can be taken wherever desired; or, two counters can be operated by the one photoelectric control.

The set is composed of three units: magnetic counter, photoelectric relay,

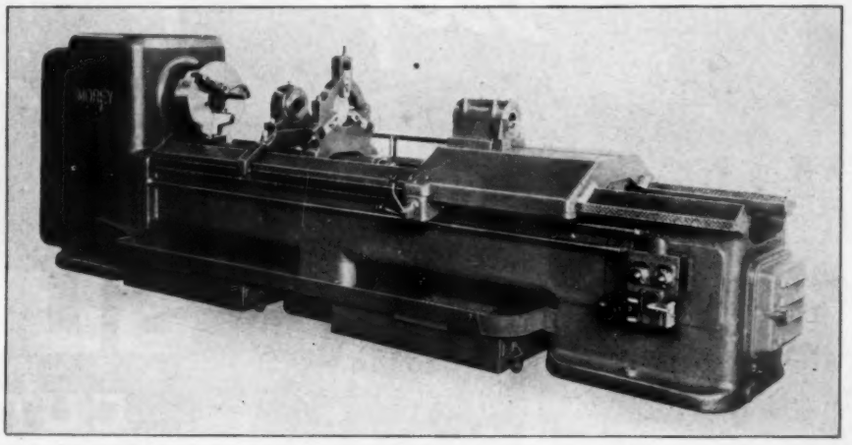


and beam projector or light source. It operates from a lighting circuit of 6, 110, or 220 volts a.c. It is especially adapted for counting objects of odd shapes and sizes, items that are small and extremely light in weight, and articles whose finish must not be marked during the process of counting. The counter has a speed of 500 counts per min., and is available in five or six figures capacity.

Morey Announces Deep-Hole Drilling Machine For Boring Gun Cylinders

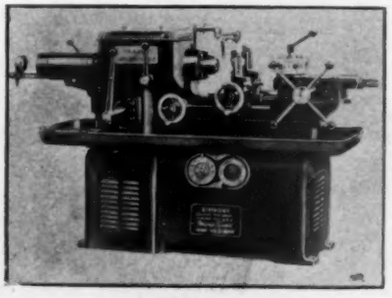
Designed especially for drilling, boring and reaming 155-mm. gun recoil cylinders and gun barrels, a new 27-in. deep hole drilling and reaming machine has been announced by Morey Machinery Co., Inc., 410 Broome St., New York, N. Y. Morey builds the machine in any length to suit specific needs.

Spindle speeds to suit the work are obtained by pick off gears. Feed and power traverse in both directions are hydraulic and are infinitely variable from ⅜ in. per min. to 75 ft. per min. An essential feature of the design is two levers in the operator's position that control the entire operation of the machine. A coolant system is provided with safety devices to instantly stop the machine for all contingencies, such as failure of the lubricant supply, dull drills, hard spots in the material.



Larger Gear Pumps Added to Hydro-Power Line

A new larger size gear-type hydraulic pressure generator, Model G-60, has been announced by Hydro-Power Systems, Inc., Mount Gilead, Ohio. The pump, a constant-delivery type, has a delivery of 60 gal. per min. at 1,000 lb. per sq.in. line pressure. Construction is unusually heavy. Close tolerances maintain high output efficiency. Precision spur gears of narrow width and large pitch diameter are used, reducing both the hydraulic load on the gears and the distance between the gear shaft bearings so that shaft deflection is minimized. Gear shafts are mounted on precision Timken tapered roller bearings. Internal adjustments are provided for compensation for bearing wear. The Model G pump is recommended for operation at 1,000 lb. per sq.in. on such applications where peak pressures are momentary; or for operating up to 500 lb. per sq.in. continuous pressures.



Simmons Machine Tool Adds Cabinet Base to Lathe

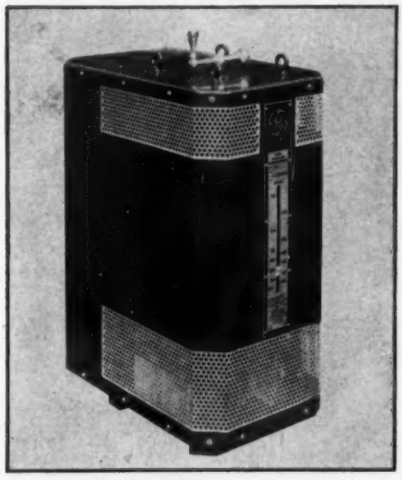
The Simmons Machine Tool Corp., of Albany, N. Y., has just added a cabinet base and selector dial control to the design of its new No. 2 turret screw machine (*AM*—Vol. 84, page 733). The selector dial control is located immediately on the front within instant reach of the operator. All electrical equipment is mounted within the new cabinet base. Also, the headstock of the Simmons turret screw machine is now equipped with a spindle brake which can stop the machine instantly under all operating conditions. Principal feature of the No. 2 turret screw machine is the "Micro-Speed" drive

NEW KIND OF TROUBLE SHOOTER. For many years past, Revere Copper and Brass Incorporated has believed that the best way to avoid trouble is to *prevent* it. Reg Marsland is one of the dozens of Revere's trouble preventers. Step by step as your order goes through Revere's mill, he acts as a "watchdog" on specifications and procedures. The silent unfailing work of the Revere Methods Man is only part of Revere's service. But it is, perhaps, as important in speeding up defense production as any other. For it insures your getting the right metal at the start. **Revere Copper and Brass Incorporated, 230 Park Avenue, New York.**

unit which provides 1,000 spindle speeds at the twist of a handwheel. Built into the machine base, this unit enables the operator immediately to select the best spindle speed for the stock being machined.

G. E. Announces Improved Atomic-Hydrogen Welders

Improved designs of 35- and 75-amp. atomic-hydrogen arc welders have recently been made available by the General Electric Co., Schenectady, N. Y. Atomic-hydrogen welders are finding increasing use in industry for

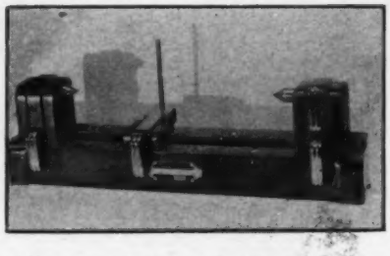


repairing tools and dies; for filling in flaws or blow-holes in steel and bronze castings; and for the fabrication and repair of hard-to-weld metals. The new welders are compact and self-contained to reduce space requirements and for increased portability and pleasing appearance. Instead of the transformer and reactor used in previous units, it has a specially designed reactive transformer which combines the functions of both. Weight of the welder has been reduced more than 30 percent and electrical characteristics are improved.

Built-in power-factor correction, a feature of the new welders, helps to reduce installation cost and avoid power-factor penalties. Fan-forced ventilation provides cool operation even at high currents or on high duty cycles.

Barber-Colman Bench Center Simplifies Inspection

An improved bench center for inspecting a wide variety of small work up to 6½ in. dia. by 18 in. long, announced by Barber-Colman Co., Rockford, Ill., provides an accurate, fast method for inspecting cylindrical and circular pieces. A quick-acting lever on the tail center, when moved to the left, clamps the center. When moved to the right it unclamps and retracts the center all in one motion. The ways have been improved in design so that all three

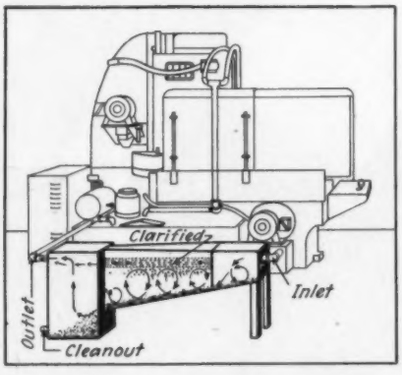


sliding members locate from the same reference surfaces, insuring accurate base for sliding indicator with relative location of centers at any point along the bed. Quick-acting power clamps hold indicator base and centers rigidly in position. The base is of nickel cast iron and is of well ribbed box construction with finished ways cast integrally.

The work, mounted on the centers or on an arbor which in turn is mounted on the centers, is inspected by being rotated by hand under a dial indicator which registers the amount of run-out or eccentricity. Work can also be checked axially to determine side run-out or "camming" action on the sides of shoulders or collar.

Gale Interceptor Reclaims Lube and Cutting Oils

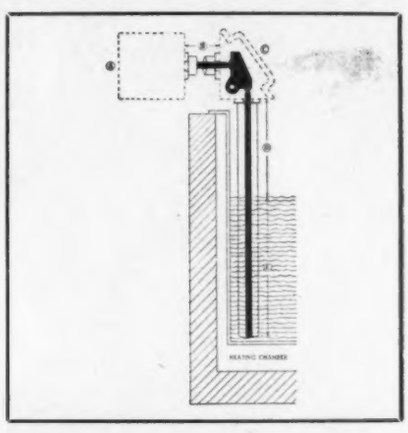
Cutting oils, coolants, and lubricating oils, many of which are expensive special compounds, can be reclaimed by the Gale interceptor and reclaimor manufactured by the Gale Oil Separator Co. Inc., Chrysler Bldg., New York,



N. Y. When cutting oils or coolants flow into the interceptor, the mixture of grindings, metal particles and oil is directed downwardly, and is at once broken apart by a specially designed breaker wedge. This wedge accomplishes three functions: slows incoming liquid, directs the lighter cutting oil or coolant upwardly to the surface, and sends the heavier materials through the bottom of the interceptor. The lighter liquid on the surface, flows to the outlet and into a filter compartment where final clarifying occurs. The interceptor operates entirely by gravity, has no moving parts. Residue can be dumped in a few moments from an easily handled bucket. The interceptor can be built in sizes ranging upward from 5 gal. per min. In addition to application on coolant lines, the Gale interceptor and reclaimor can be used to clarify dirty oil removed from combustion engines, ice machines, electric motors, automatic tool machines, elevators and similar equipment.

Burling Heat Control Angle Hugs Kettle Closely

Perpendicular temperature control instruments can be securely attached to a kettle, pot or any other heating container in such a way as to keep the tube of the instrument as close to the side walls as possible, by a device known as the Burling Klosefitting heat-control actuating elbow or angle fitting just placed on the market by the Burling Instrument Co., Newark, N. J. It consists of a hollow casting containing a fulcrum device, one end being in alignment with an opening in the bottom of the fitting and the other part in alignment with an opening in the side. Into the bottom outlet is screwed the lower tube of the



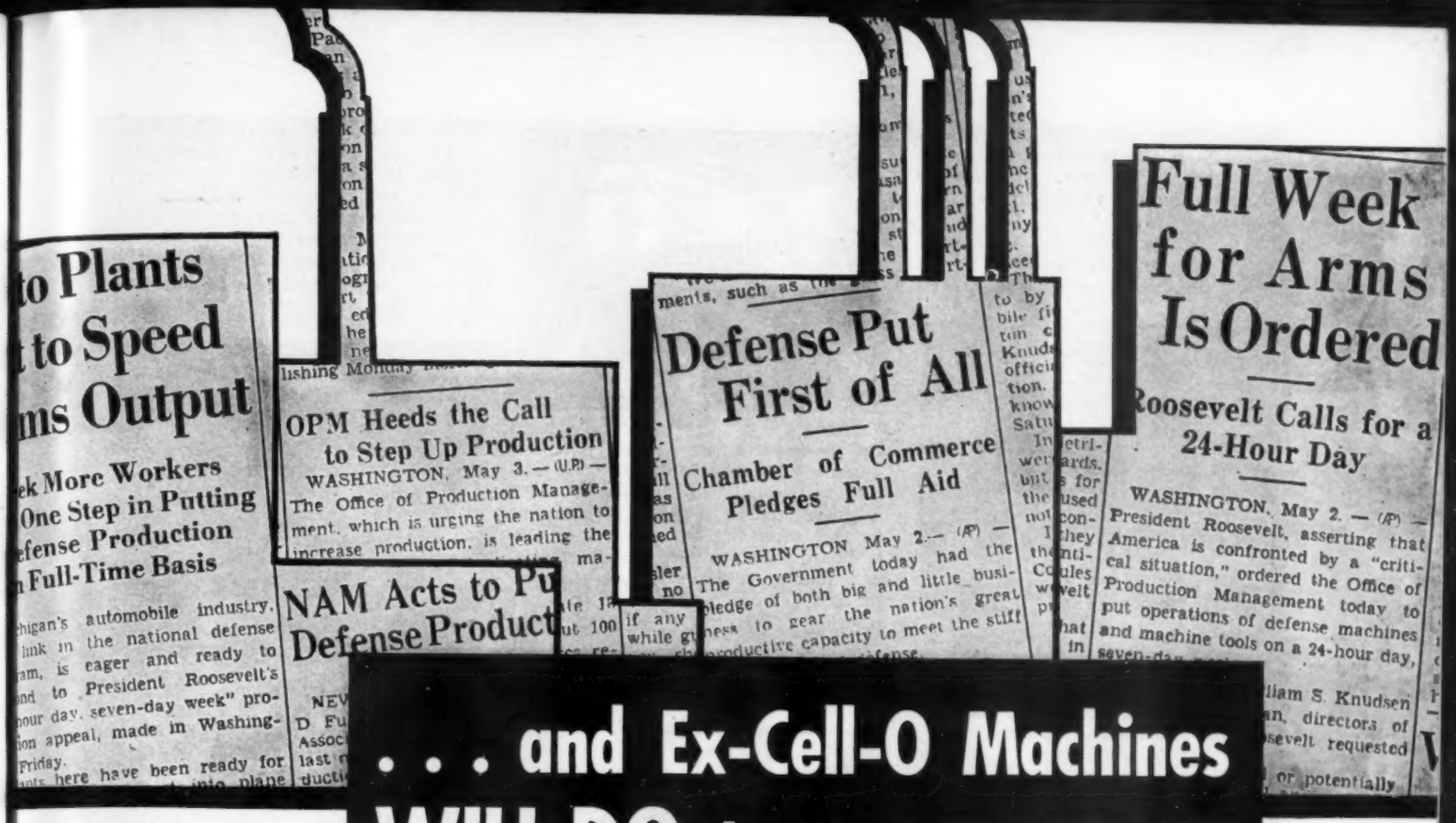
instrument—the active or sensitive part. Into the side opening the extension tube is fitted, its other end being attached to the instrument head. The slightest contraction or expansion of the tube in the heated media instantly actuates the lever in the L-fitting which in turn continues the proper expansion or contraction movement to the upper main working parts of the instrument.

Holophane Controlenses Control Fluorescent Light

Three prismatic glass lenses, known as "Fluorescent Controlenses," are now available from the Holophane Co., 342 Madison Ave., New York, N. Y., for controlling fluorescent lighting.

The first, known as the Intensive Controlens, produces the distribution of light most commonly used in both commercial and industrial interiors—normal "uniform spacing" lighting on horizontal surfaces in rooms of normal height.

The second, Concentrating Controlens, produces a confined focusing



. . . and Ex-Cell-O Machines WILL DO the Precision Work!

WITH their continuous operation the imperative demand of the day, the machine tools of the nation's industry must now really "take it." Day and night they must produce to the utmost—with unfailing accuracy. . . . Ex-Cell-O machines are built for just this kind of a job—for the most exacting type of precision work under high and steady production. Every Ex-Cell-O product—machines and tools for boring, turning, facing, for thread grinding, for lapping, for carbide tool grinding, for many other machining operations—represents the soundest engineering design, the most expert workmanship, the finest practical materials, a combination that has made the name Ex-Cell-O a familiar and outstanding one in every industry where accuracy and speed are essential in the production of metal parts. This is why manufacturers depending upon Ex-Cell-O machines in their plants under the nation's accelerated defense program are assured of maximum productivity.

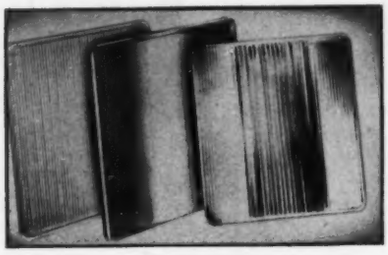
EX-CELL-O CORPORATION • DETROIT, MICH.

XLO

Precision **THREAD GRINDING, BORING AND LAPPING MACHINES, TOOL GRINDERS, GRINDING SPINDLES, HYDRAULIC POWER UNITS, DIESEL INJECTOR PUMPS, BROACHES, CUTTING TOOLS, DRILL JIG BUSHINGS, ETC.**

type of light distribution. This lens has several common applications—accent lighting, general illumination from great mounting heights, or "offset beam" lighting.

The third, the Extensive Controlens, is particularly adaptable for areas where the lighting of vertical surfaces

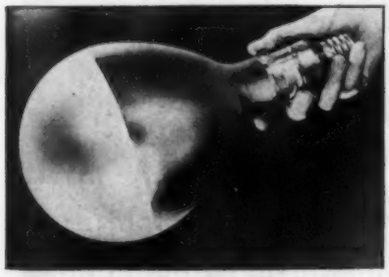


is desired or in low ceiling areas to permit economical wide spacing of units.

Lighting fixtures using these prismatic lenses are available for three types of installation: recessed flush with the ceiling, close-up to the ceiling, and suspension mounting.

High-Voltage Lamp Added To Birdseye Line

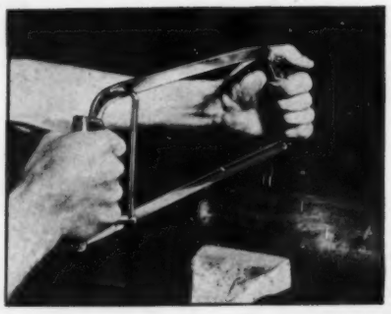
A new Birdseye high voltage lamp, made with its own built-in reflector unit in the form of a solid silver lining hermetically sealed inside the bulb where it cannot gather dust or tarnish, has been announced by the Wabash Appliance Corp., Brooklyn, N. Y. A



nickel neck reflector disk redirects light that would ordinarily be wasted through the neck of the bulb. The combination of neck reflector disks, pure silver linings and exact optical placement of the filament is said to direct a concentrating flood of light rays straight out of the bulb directly to the work area to be illuminated. Available in six sizes from 100 to 1,000 watts, and in seven different high voltages from 220 up to 300 volts.

Guarded Hacksaw Frame Introduced by Rapid

Heavy duty hacksaw frame, claimed to be the only hacksaw frame with a guard to prevent skinned knuckles from accidental contact with rough edges of sawed metal, has recently been introduced by Rapid Mfg. Co., Glendale, Calif. Another feature of



the hacksaw frame is the patented automatic tension lock. By cam action in the handle, the blade is held at high tension, yet can be changed in two seconds. In addition to the standard all-steel, deep throat models, a combination frame can be changed in 30 sec. from conventional to taper position. This model is particularly suited to work in tight corners, on angle cuts, and for deep cuts below the level of the handle.

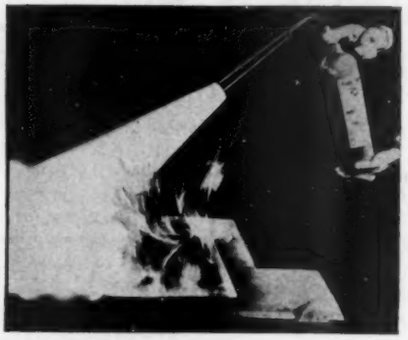
DeBothezat Man Cooler Reduces Heat Fatigue

Workers who are exposed to radiant heat from ovens, furnaces, forges and molten metal, can be given relief from the intensive heat by a new man cooler announced by the DeBothezat Ventilating Equipment Div., American Machine and Metals, Inc., East Moline, Ill. Called the "Hy-V" air jet, the new man cooler is column-mounted and adjustable to blow in any direction. It projects a blast of cooling air in a concentrated stream to remote spaces without the aid of ducts. It has been especially designed for reducing fatigue of workmen in foundries, forge shops and steel mills. Fan sizes available range from 18 to 30 in. dia., with capacities ranging from 2,100 to 11,420 cu. ft. per min.; nozzle velocities range from 2,340 to 5,780 ft. per min.

Carbon Dioxide Extinguisher Now Operated by Trigger

Speedier fire-fighting operation has been added to the 4-lb. carbon dioxide extinguisher announced by Walter Kidde & Co., Bloomfield, N. J. The trigger control valve recently developed by this company for its 2-lb. unit is now standard equipment on the new type 4-lb. model.

This extinguisher is discharged by simply pulling a trigger. This type of discharge control not only permits the extinguisher to go into action faster,

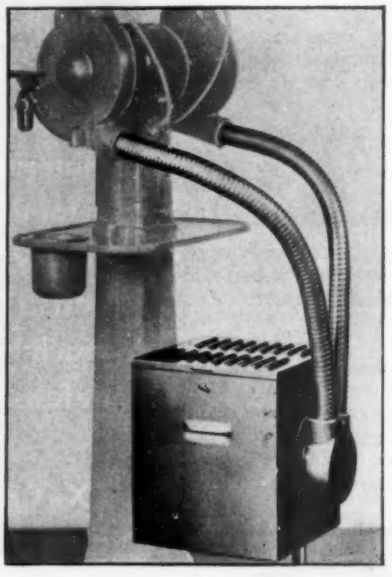


but also insures no wasting of the carbon dioxide gas while the operator is maneuvering around the blaze. When trigger pressure is released the discharge is shut off. The nozzle arm is equipped with a swivel, so that the discharge is held in a "down" position when the extinguisher is not in use.

Aget Unit Dust Collector Can Be Rapidly Installed

Designed to exhaust one or more pedestal or bench grinders, cut-off machines, polishers, buffers, etc., a new low-cost unit-type dust collector having a rating of 600 cu. ft. per min. is now available from Aget Mfg. Co., 424 Book Bldg., Detroit, Mich. Being entirely self-contained and not requiring connecting in with a centralized collecting system, the "Dustkop" permits rapid installation and even subsequent moving of the machine and collector as a unit.

Known as "Dustkop 600", and equip-



GEAR PRODUCTION HEADQUARTERS

The Michigan line of products, today, comprises what is probably the most comprehensive line of gear production aids in industry — developed through the years in answer to specific needs of gear producers and users.

With a continuously expanding line of products, Michigan engineering services have similarly grown to help industry solve its gear-production problems.

Those services are yours for the asking— at "Gear Production Headquarters."

MICHIGAN TOOL Company

7171 E. McNichols Road, Detroit

IS YOUR ASSEMBLY DEPT.

CLOSED TO SABOTEURS

..BUT OPEN TO "DOUBTFUL" SCREWS?

Guarantee
OF HIGHEST QUALITY
To assure satisfactory performance, Parker-Kalon Fastening Devices are made to exacting specifications covering dimensional and physical characteristics which are checked at every stage of manufacture, and passed upon by Parker-Kalon's Quality Control Laboratory. Should this product prove faulty in any way, replacement will be made without charge
PARKER-KALON CORPORATION
NEW YORK, N. Y., U. S. A.

Parker-Kalon's Quality-Control GUARANTEE stands guard against work-interrupting fastening devices!

Plant guards are powerless against "doubtful" screw infiltration. Yet these trouble-makers can sabotage assembly schedules – cause rejected parts – run up costs in a way that's plenty serious!

You have one SURE protection against "doubtful" screws . . . screws that *look* right but some of which don't work right. That is the famed Parker-Kalon Quality-Control Laboratory! Without counterpart in the industry, this $250,000 department in the Parker-Kalon plant applies a unique test-and-inspection routine that eliminates "doubtful" fastening devices from your work.

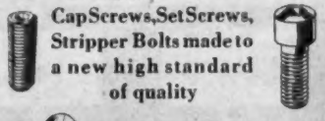
When you specify *Parker-Kalon* you can be sure that *every* screw will be uniformly good in all physical and mechanical characteristics. You can be sure that *every* screw will go in easily and hold securely, even under unusual strains. Parker-Kalon Corporation, 194-196 Varick Street, New York, N. Y.

SOLD ONLY THROUGH RECOGNIZED DISTRIBUTORS

COSTS NO MORE *to get this Parker-Kalon Quality-Control Guarantee with every box of....*

Hardened Self-tapping Screws
Types, sizes, head-styles for every assembly of metal or plastics

Cold-forged Socket Screws



Cap Screws, Set Screws, Stripper Bolts made to a new high standard of quality

Thumb Screws • Wing Nuts
Cold-forged . . Neater, Stronger

PARKER-KALON *Quality Controlled* **FASTENING DEVICES**

ped with a ¼-hp., 3,450-r.p.m. motor which has a waterlift rating of approximately 3.3 in., it is sufficiently compact to be mounted on a grinder. Two types of intake flanges are available to exhaust stations singly or in multiple. Removal of collected dust is by lifting the cover, taking out the filter assembly, and lifting out the pan, into which the dust has fallen after being stopped by the filter. Filters are of spun glass, and are quickly renewable at low cost.

Hygrade Fluorescent Unit Produces Intense Illumination

Two 100-watt fluorescent lamps are used in the F-235 "Miralume" fluorescent unit announced by the Hygrade Sylvania Corp., Salem, Mass. Designed to bring large quantities of light to aid working efficiency in industrial plants, it gives a lumen output of over 8400. This permits wider spacing and makes the unit ideal for mounting near the ceiling in high-studded areas.

Reflector is easily demountable. It is drawn from a single piece of 20-gage metal, not welded, and there are no bolts or nuts to break up the smooth porcelain enameled reflecting surface. This feature also eliminates the possibility of chipping or cracking the enamel under or near the bolt heads. Working parts are carried in the housing. The reflector carries only its own weight.

Gilmer Belt Suitable For High Speed Precision Work

The Gilmer-Hevaloid belt, just announced by the L. H. Gilmer Co. Tacony, Philadelphia, Pa., is an endless belt especially suited to high speed precision work. The unique process of impregnating the cotton pulling element with latex is said to form a material that is virtually homogeneous, resulting in special qualities of elasticity, strength and durability. Made without lap, seam or splice, the belt operates free from vibration. Non-slip surface with high coefficient of friction permits lighter tension, decreasing bearing load, and a higher and more uniform belt speed on drives such as for routing machines, winders, grinders and similar applications. Pliability for use over small pulley diameters and lightness in weight adapt it for operation at speeds up to approximately 9,000 ft. per min.

Houghto-Black Process Blackens Steel Parts

A rapid, controllable and durable blackening process for steel parts is now being offered by E. F. Houghton & Co., Philadelphia, Pa. Known as "Houghto-Black" the process is a low-temperature salt which is mixed with water and held at the boiling point of the solution (around 290 deg. F.), while

You can't tell King Zeero they're all alike!

The King Zeero Company

MANUFACTURERS OF REFRIGERATING EQUIPMENT
1881-83 PLYMOUTH AVE.
Chicago, Ill.

February 6, 1941

Parker-Kalon Corporation
200 Varick Street
New York, N. Y.

Gentlemen:

We have a very tough application for your socket head cap screws. We use them for securing a flange plate to a steel block. A 1/8" thick aluminum, or copper gasket is placed under the screw head and the screw is pulled down hard enough to make a gas tight joint with a 250# air test.

We started using your screws four years ago and are very pleased to advise that only one screw head broke off in that time. This is a marvelous record and we are

We had so many broken screw heads of other makes that we were changing the valve design, to eliminate socket cap screws, when a supply house salesman induced us to try Parker-Kalon. We bent the wrench trying out the first screws without breaking the heads. Nothing but Parker-Kalon have been used by us since that time.

By: J. I. Morrison.
J. I. Morrison.

JIM:g

They HAD to Find "Better Than Good" Screws —

and like hundreds of hard-to-please buyers, King Zeero found that Parker-Kalon's Quality-Control shows up whenever unusual strains are imposed. This unequalled 16-point control eliminates "doubtful screws" . . . screws that *look* right but some of which don't *work* right, causing costly delays, rejects and complaints. Specify PARKER-KALON and be sure your socket screws are *better* than "good"! Parker-Kalon Corporation, 194-196 Varick Street, New York, N. Y.

Quality-Controlled

16-point test and inspection routine covers: Chemical Analysis; Tensile and Torsional Strength; Ductility; Shock Resistance under Tension and Shear; Hardness; Head diameter, height and concentricity; Socket shape, size, depth and centricality; Class 3 Fit Threads; Clean-starting Threads.

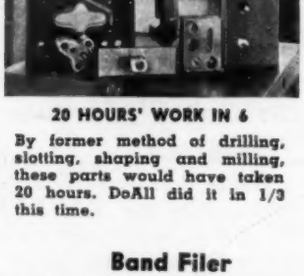
PARKER-KALON
Quality Controlled
SOCKET SCREWS

DoAll Works like Magic

AT GONDA ENGINEERING CO. SALEM, OHIO

8 HOUR JOB IN 1½

Drill Fixture cut from a solid piece in less than 1/5 former time. Note, slug is salvaged.



20 HOURS' WORK IN 6

By former method of drilling, slotting, shaping and milling, these parts would have taken 20 hours. DoAll did it in 1/3 this time.

• The parts shown above were cut in one eight-hour day on the DoAll. At least five days would have been required by drilling, shaping, milling and boring.

The DoAll enables Gonda to make excellent deliveries to their customers; also releases the other machines for work more suited to them.

Today, every plant where metal is used, needs the DoAll Contour Machine to get work through on schedule.

One of our factory trained men will call at your plant to show you what a DoAll can save for you. Don't delay—Write today!

Band Filer

Does faster, better, smoother continuous filing on all materials from high-carbon steel to brass, wood, etc. Your choice of 23 styles of file bands, ½", ⅜" and ¼" wide, flat, oval or half round. DoAll Band Files are remarkably efficient—5 times as fast as jig filing.

DoAll Grinder

A super precision surface grinder—a real production tool. Less vibration because motor is built right on ball-bearing spindle. Work table has exceptionally large bearing surface. Hydraulic table travel is infinitely variable, up to 50 f.p.m.

FREE—Literature and technical data on Contour Machining.

DO-ALL Contour Machine BAND SAWING BAND FILING BAND POLISHING

CONTINENTAL MACHINES, INC.

1310 S. Washington Ave. Minneapolis, Minn.

Associated with the DoAll Co., DesPlaines, Ill., Manufacturers of Band Saws and Band Files for DoAll Contour Machines.

the parts to be blackened are dipped into the bath. Only a few minutes immersion are required as compared with more labor and longer time for the old browning and rusting process. Parts should be chemically clean before immersion. Bath treatment should be followed with a cold and a hot rinse, after which the parts are ready for assembly. The lustrous black finish is achieved without any change in dimensions.

Thermoid "Thiokol" Hose Handles Paint and Solvents

Thermoid Co., Trenton, N. J., has developed the "Thiokol" synthetic rubber hose especially for long-life service, handling paints, varnishes and similar compounds containing strong solvents. The hose is reinforced with plies of tightly woven cotton braid and is covered on the outside with an abrasion-resisting rubber. It is furnished in lengths of 25, 50 and 500 ft., in ¼, ⅜ and ½-in. sizes.

NEW MATERIALS

Wayne "Nonscratch" Lubricant Aids in Drawing Cartridge Cases

Wayne Chemical Products Co., 9450 Copeland Ave., Detroit, Mich., has developed No. 1025 "Nonscratch" Lubricant especially for drawing cartridge cases of the 75 mm. size and larger. This compound is diluted with five times as much water in making the lubricating solution. It is claimed that tests indicate it will produce over 100 percent more casings between stops for die honing than similar compounds.

Eastman Kodak Transfer Film Sensitizes Metal Plates

Matte Transfer Film, a photographic material for sensitizing metal plates for use in a templet production process which for some time has been shortening the period between engineering and test flights in the aircraft industry, has recently been made available to all industries by the Eastman Kodak Co., Rochester, N. Y. With the use of Matte Transfer Film, engineering drawings can be printed either by contact or by projection on photosensitive metal sheets. Processed plates bearing the photographic image are then sent directly to the templet department to be cut out and used as a pattern.

The most simple and effective method of producing sheets of photosensitized metal consists of laminating Matte Transfer Film to lacquered metal sheets. The film consists of a sensitive emulsion coated on a thin film support, the latter backed by a paper base. When used, the sensitized strip is transferred from the paper base to the lacquered metal plate. The film has a matte surface so that it will take a pencil line in case changes or addi-

tional developments on the processed photographic image are desired.

At the present time the width of Matte Transfer Film is limited to a maximum of 34½ in. If wider plates are desired, several strips of the film can be used. To further aid manufacturers interested in this process, the Eastman Kodak Co. will give assistance in designing and installing the equipment necessary to produce photo-templets.

TRADE PUBLICATIONS

CASTERS Metzgar Co., Grand Rapids, Mich., is circulating a four-page folder which describes and illustrates two lines of casters.

COPPER AND COPPER ALLOYS The Revere Copper and Brass, Inc., 230 Park Ave., New York, N. Y., is circulating three booklets on copper and copper alloys for (1) Mechanical Industries; (2) Process Industries; and (3) Power Plants.

ELECTRIC DRILLS The Commercial Standard of Portable Electric Drills, identified as CS93-41, may be considered effective for new production from October 18, 1941. Printed copies of the Standard, No. TS-3031, may be secured by request from the National Bureau of Standards, U. S. Department of Commerce, Washington, D. C.

GRINDING Oakite Products, Inc., 22 Thames St., New York, N. Y., is featuring a story on "The Grinding Process and Its Dependence on Efficient Cooling" which appears in the March-April Oakite News Service.

HOBBING STEEL Jessop Steel Co., Washington, Pa., is circulating a six-page folder, No. 341, which describes a soft low carbon steel used for making molds for plastic and die castings by the hob sinking method.

HOISTS Gar Wood Industries, Inc., Hoist and Body Div., Detroit, Mich., is circulating Bulletins Nos. 7, 16, and 17 which describe and illustrate hoists and dump bodies for trucks.

HYDRAULIC CYLINDERS The Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich., is circulating Catalog H-40 which describes and illustrates in 24 pages the construction and application of hydraulic cylinders. Tables indicating the pressures per square inch and dimensions are also provided.

MOTORIZED VALVES The Brown Instrument Co., Philadelphia, Pa., has just issued Catalog No. 77-1, "Brown and Minneapolis-Honeywell Industrial Power Units and Motorized Valves." A line of motor power units and motorized valves is described which are designed to operate and form an im-

(Advertisement)

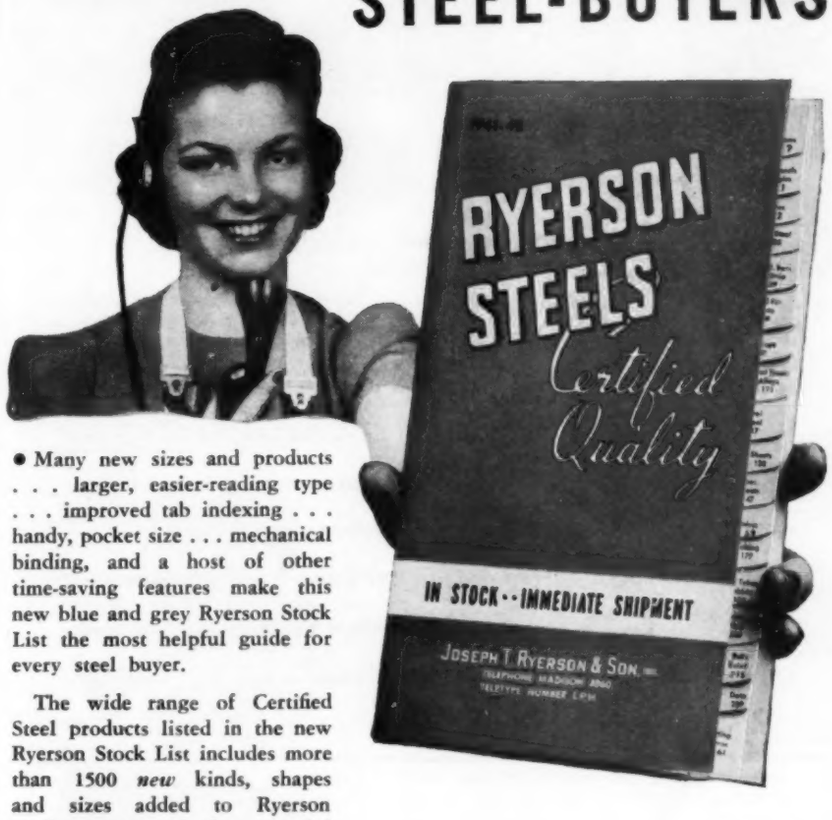
Manufacturers Look to Steel Warehouses for Quick Defense Requirements

Many leading manufacturers are relying on nearby steel-service plants for prompt, stock shipment of steel to meet the current surge of business prompted by our National Defense Program.

Probably the leading exponent of "Immediate Steel" is Joseph T. Ryerson & Son, Inc., with their net work of ten strategically-located plants, each of which is completely equipped for prompt service on steel and allied products, formed and cut to customers' exact requirements. No shop should be without the Ryerson Stock List (see advertisement below).

Thousands of manufacturers report saving considerable time, trouble and money by taking advantage of Ryerson's complete flame cutting service. Modern equipment manned by specially trained operators can quickly burn any shape—no matter how intricate—from carbon or alloy steel plates and billets up to 15" thick.

New Guide for STEEL-BUYERS



• Many new sizes and products . . . larger, easier-reading type . . . improved tab indexing . . . handy, pocket size . . . mechanical binding, and a host of other time-saving features make this new blue and grey Ryerson Stock List the most helpful guide for every steel buyer.

The wide range of Certified Steel products listed in the new Ryerson Stock List includes more than 1500 *new* kinds, shapes and sizes added to Ryerson stocks — many of them special analyses in demand for airplane construction and other exacting defense requirements.

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portant part of the control system. Included are photographs of electric control motors, slip stem globe type, rotary stem globe type, butterfly type, pilot operated, and three-way and special valves.

MOTORS The General Electric Co., Schenectady, N. Y., is circulating a 12-page bulletin which illustrates and describes induction motors.

OIL FILTER EQUIPMENT Westinghouse Electric & Mfg. Co., has published a four-page folder, No. F. 8599, which may be obtained upon request from Dept. 8-N-48, and which describes the portable system which cleans and dries the oil used in transformers, regulators, capacitors, and similar equipment.

PLATING TANKS Bulletin No. 81-2, circulated by the Brown Instrument Co., Philadelphia, Pa., illustrates and describes a new system of instrumentation for plating tanks.

PLUGGING CONTROL General Electric Co., Schenectady, N. Y., has published a four-page folder, No. 8490, which illustrates and describes the construction and operation of plugging control.

PUMPS Allis-Chalmers Mfg. Co., Milwaukee, Wis., has issued a comprehensive 40-page bulletin, No. B-6146, for every pumping service requiring a high-grade, single-stage double-suction centrifugal pump. In addition to construction features, pump dimensions, normal and special application data, this profusely illustrated bulletin presents friction tables, head-capacity tables, and other valuable pump engineering information.

RECORDERS A new 16-page bulletin, No. 570, has just been published on strip-chart records by the Bristol Co., Waterbury, Conn. The publication illustrates and describes these instruments which are used for measuring and recording on a six-inch strip chart d.c. amperes and milliamperes, d.c. volts and millivolts, pressure, liquid level, flow, mechanical motion, and for remote recording.

TESTING MATERIALS Bulletin No. 101, "The House of Stearns Magnetic Magic," describes newly enlarged laboratory facilities and equipment for making tests of materials in order to determine the best methods of solving industrial and mining problems. The bulletin is being circulated by the Stearns Magnetic Mfg. Co., Milwaukee.

WELDING The Electric Controller & Mfg. Co., Cleveland, Ohio, is circulating Booklet No. 141, "The Theory and Application of Resistance Welding", at a cost of ten cents each. The company is also circulating Bulletin No. 1201, without charge, which illustrates and describes the construction and operation of weld timers.

NEW BOOKS

PRACTICAL AIR CONDITIONING—*By Adolph J. Rummel and Lewis O. Vogelsang. 282 pages. Published by John Wiley & Sons, 440 Fourth Ave., New York. $2.75.*

This is a practical volume for those in the air-conditioning field and those about to enter it. It considers first the fundamental principles of the subject, namely the relation of air temperature, humidity and motion to human comfort. It discusses various systems for air conditioning, and then goes to the many types of equipment that have been developed for putting the systems into effect.

The book is compiled largely from courses of instruction compiled by the authors for dealers, salesmen, operators and servicemen. It includes not only the means of selecting and setting up equipment, but also its inspection, operation and maintenance.

•

DESCRIPTIVE GEOMETRY: SEVENTH EDITION—*By H. W. Miller. 254 pages. Published by John Wiley & Sons, 440 Fourth Ave., New York, N. Y. $2.50.*

Descriptive geometry is a required subject in practically all courses of mechanical engineering. This particular treatment of it has had a long history.

The classic work of Professors Warren and Church in 1860 and 1864 was rewritten by the present author in 1910. Since that time he has found it necessary to revise the book repeatedly in order to keep pace with new developments and modern methods of teaching.

While departing from the purely abstract method of teaching the subject, Mr. Miller has avoided too high a degree of specialization in order to retain a general approach to basic principles, rather than infringe on the field of the handbook and the formula.

The volume is well illustrated with perspective views and includes problems with each chapter.

•

BLUEPRINT READING, CHECKING, TESTING—*By Otto A. Steinicke, department of drawing, Beaver Dam (Wis.) High School. Published by McKnight & McKnight, Bloomington, Ill. Part I, $1.20; Part II, 80 cents.*

Because of the urgent need for more mechanics and draftsmen there has been a wide demand for instruction books for the beginner. Many of these have to do with the subject of blueprint reading. This pair of paper-bound books has the merits of brevity and simplicity. Part I, the instruction book, includes an index and a single-page account of the procedure to be followed. Following this is given a paragraph of information on each of 39 drawings and a series of questions

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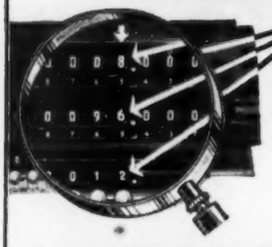

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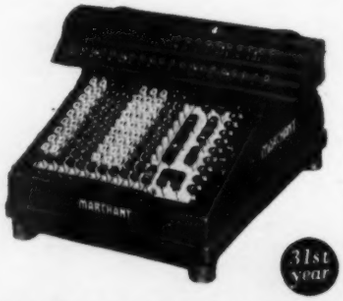

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concerning each one. At the back of this volume is to be found a series of tables and other reference data frequently used.

Part II gives in blueprint form the drawings referred to in Part I. Each object so detailed is shown in prospective, and on the facing page, as a conventional blueprint with white spaces left for the dimensions. The student is to fill in the dimensions from the prospectives and then remove the perforated sheet for collection by the instructor.

Nothing is given on the theory of projection or the whys and wherefores of mechanical drawing. The sole objective seems to be to familiarize the student with blueprints in the shortest way possible.

•

RUNNING A MACHINE SHOP—*By Fred H. Colvin and Frank A. Stanley. 449 pages. Published by McGraw-Hill Book Company, 330 W. 42nd St., New York, N. Y. $3.50.*

This manual of tested plans and methods of shop layout, equipment, production control and personnel management for large and small machine shops has been prepared as a result of long years of experience both in the shop and in close contact with shops in many localities. First-hand observations by the authors have convinced them that many of the problems that confront the manager are the same, regardless of the size of the shop. The information and suggestions contained in this volume have come from varied sources, including both large and small shops, and it should be remembered that plans and methods which have proved successful in one shop may fail in another because of entirely different conditions in the other shop. In fact, the authors recommend the adaption of the ideas presented, rather than their adoption.

The contents of the book have been divided into eleven chapters, and each is illustrated with line drawings, photographs and charts or tables to assist in making the various points considered important. The authors first discuss briefly modern machine shop practice, and point out that new machines, new methods and new material "make it necessary for the men who are engaged in machine work, whether as owners, managers, or workers, to have a wider knowledge than ever before of the things that affect their industry." In addition to discussing principles involved in planning a shop, selecting equipment, and arranging for materials handling and tool cribs, the authors devote separate chapters to production control, estimating, apprenticeship and training, management, foremen and personnel relations, and inspection systems. Practical examples of systems that have worked in various shops are given throughout the text.

ENGINEERING DRAWING—*By Thomas E. French, professor of mechanical drawing, Ohio State University. 622 pages. Published by the McGraw-Hill Book Co., 330 W. 42nd St., New York, N. Y. $3.00.*

As contrasted with some of the current manuals, designed to give the apprentice a quick acquaintance with blueprint reading, this classic textbook on the subject of engineering drawing gives a thoroughgoing treatment of the subject. It is the basis of a course of study consisting of a series of problems based on a study of the text.

This sixth edition brings the book in line with modern practice, both as to the text and problems. Such late developments as aircraft jig and fixture drawings have been included.

The book opens appropriately enough with the tools of the designer: instruments, drawing boards, T-square, triangles and all the various paraphernalia that a good draftsman needs. It goes on to the construction of geometric shapes and transfers the principle thus developed into machine elements. It describes dimensioning and conventional symbols, and concludes with practical problems taken from the field of the machine shop, architecture and engineering construction.

The Man Behind The Machine Tool

BY FRED H. ZOELLNER
Director of Machine Shop
Ohio Mechanics Institute

The man behind the machine tool (the mechanic) is the man who makes it possible for the man in front of the machine tool (the operator) to obtain maximum production from that machine. If 't were not for the services of the mechanic whose responsibility it is to keep the machines in the "pink of condition," the operator, no matter how skilled or proficient he is in the operating of that machine tool, finds his efforts are in vain.

This fact should be kept in mind in organizing training programs for the present "emergency" as well as for the future. Please don't misunderstand—we need machine tool operators in ever increasing numbers, and the schools, industries and the small shop around the corner are cooperating to the fullest to achieve this end. Theirs is a commendable piece of work. But during a "state of emergency" we are likely to become near-sighted in our vision concerning the future.

Granted, our present-day modern precision machine tools are designed and built to produce more for less and to last longer but there will come a day when these machines will need replacement parts. Then we shall be confronted with the problem of securing or training maintenance mechanics, instead of operators, to make the necessary repairs. It is generally conceded

that a skilled machine operator doing repetitive production work is not always a skilled mechanic capable of restoring a machine to its original state of efficiency. A man may be a skilled bus driver, but it does not follow that he is capable of overhauling the motor. A machine tool mechanic is one who understands the theory and possesses the ability and skill to put that theory to practical use.

Bear in mind the machine tool industry more than doubled its capacity during the past year and is now being called on to again do the "impossible." This means that many hundreds of new machine tools of all descriptions will have to be "manned and maintained." Let's not be content merely to train operators but in addition devote a portion of our training program to the serious business of developing men as mechanics. For when this emergency has passed and we return to a state of normalcy we will be forced to utilize the equipment on hand to the fullest in order to meet competition. This means that the machines "used and abused" will of necessity have to be reconditioned.

Women In War Work

Women in industry is a war problem which many seem to have forgotten. This may be caused partly by the number of unemployed men, but few younger men seem to know of the important part women played in the last war. While most of their work was of the lighter sort, there were cases where they handled fairly heavy shell work satisfactorily.

Modern machinery makes it possible for women to do many operations on munitions and even on machine tool work. Fuse making in some ways is comparable with clock shop work, where women have worked for years. They also excel in many kinds of inspection work. Delicacy of touch and dependability are usually two outstanding characteristics of the woman worker.

While women toolmakers are scarce, there are a few, and good ones. Not many women are mechanically minded enough to handle the all-around toolmaker's job, but there are exceptions. One, I recall, who kept her job in a large toolroom long after the war, had one unusual qualification. The toolroom foreman, who was tough spoken had opposed hiring her. She won out, so that superintendent told me, because she could "out-cuss" him.

As toolcrib attendants women have proved of great value. They soon learn the names of the various tools. They usually keep the toolcrib neater than the average man, and as in inspection work, they are dependable. Shop managers who complain of inability to get enough men for the increased production demanded, might well consider utilizing women to relieve men who can be more useful on actual production.

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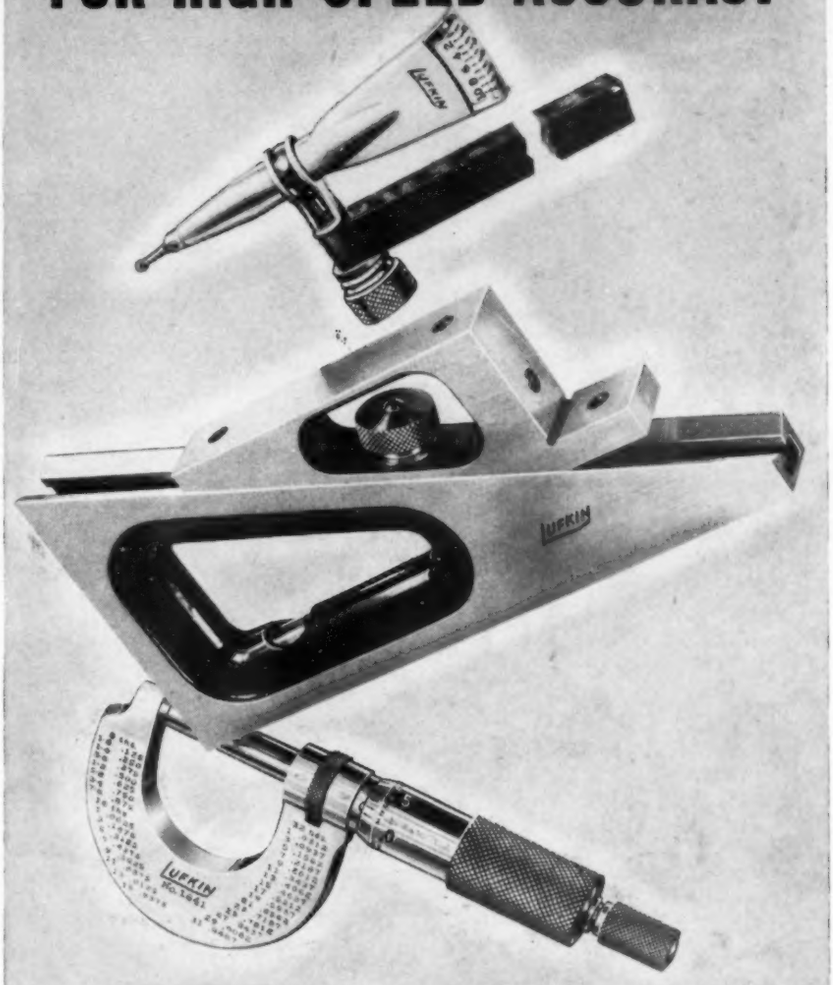

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2. **How fast** is aluminum needed?

   We don't know, for sure, but just as fast as the aircraft plants, munition plants, shipyards, and the like, can be expanded to use aluminum and other materials for defense purposes.

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